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UTILIZATION OF DOGWOOD AND PERSIMMON

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IMPORTANCE OF DOGWOOD AND PERSIMMON

The woods of flowering or eastern dogwood (*Cornus florida*) and persimmon (*Diospyros virginiana*) are important in American industry not because of the quantity consumed but because of the unusual combination of properties which fits them for special uses. Other woods have some of the same properties, such as hardness, toughness, fineness of texture, and smoothness when subjected to wear, but few if any possess them all to such a degree as dogwood and persimmon. This combination of properties is of special value for shuttles, bobbins, spool heads, golf club heads, infants' shoe lasts, small handles, brush backs, turnpins, mallets, pulleys, and many novelties.

Shuttle blocks and shuttles, for which dogwood and persimmon, together with a small quantity of boxwood, are the only woods used at present, stand out in importance far above the other products mentioned. Shuttles are indispensable to the cotton, woolen, and silk mills of the country, representing a capitalization of over $5,000,000,000. Also there is a constant demand from foreign countries for over half the shuttle blocks manufactured here.

The demand for dogwood is met with difficulty, and for a number of years the wood has commanded a higher price than most other woods native to the United States. The supply of sizable logs is limited and clear pieces are not easy to obtain from dogwood bolts. Dogwood is generally preferred to persimmon, but the proportion of

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persimmon consumed for squares or small dimension material as well as for shuttles is gradually increasing, chiefly because more persimmon than dogwood is available and because persimmon as a general rule is larger and less defective. Like dogwood, it has commanded a higher price than most other woods native to the United States.

Price data covering any period of years for dogwood and persimmon dimension stock and persimmon lumber are scanty. The reports of prices received by the Forest Service and the Bureau of the Census from dealers in dogwood and persimmon, although erratic and inconsistent from year to year, indicate that the price for each wood has risen steadily during the last 15 years. Users of dogwood and persimmon find themselves paying more each year for small dimension stock, and find increasing difficulty in obtaining suitable material, especially dogwood, as the supply of sizable timber diminishes.

TABLE 1.—*Characteristics of the Dogwoods*

Name	Range	Maximum size		Color of wood		Color of flower	Color of berries
		Height	Diameter	Heartwood	Sapwood		
		Feet	*Inches*				
Flowering dogwood (*Cornus florida*, Linn.).	Eastern United States.	40	18	Reddish brown to chocolate brown.	Pinkish or light brown	Snowy white to pinkish white.	Bright scarlet.
Pacific dogwood (*Cornus nuttallii*, Aud.).	West coast States and British Columbia.	100	24	Reddish brown.	White or pale pinkish brown	Snowy white or pinkish.	Shiny red.
Blue dogwood (*Cornus alternifolia*, Linn.).	Northern United States and on the Appalachian Mountains.	30	18	Brown	Light brown.	Creamy white.	Purple
Rough-leaf dogwood (*Cornus asperifolia*, Michx.).	Central United States.	30	10	Pale brown.	Cream	do	White.

Both woods are so well suited for certain specialized articles in domestic and foreign industry, and the supply of each is so limited that they should be utilized with a minimum of waste.

THE TREES

DOGWOOD

In the whole world there are about 50 species of dogwood. Of the 16 or 17 species native to the United States only 4 grow to tree size (at least 8 feet in height and 2 inches in diameter)—flowering dogwood, Pacific dogwood, rough-leaf dogwood, and blue dogwood. Table 1 gives the chief characteristics of these four species, of which the most important commercially is the flowering dogwood. Although flowering dogwood is not so large as its Pacific relative *Cornus nuttallii*, its occurrence on a large area in the eastern part of the United States near the present consuming markets and principal points of export gives it an obvious advantage.

Flowering dogwood gets its name from the profusion of flowers that it bears in the spring. (Fig. 1.) It blooms early, in March in

the South and in May farther north. Every spring dogwood trees attract large numbers of people in search of early tree flowers. In some sections near large centers of population good specimens of dogwood have been practically wiped out by ruthless gathering of branches.

Flowering dogwood is commercially important at present chiefly in the southern Mississippi Valley, the southern Appalachian Mountain region, and in certain sections of the southern yellow pine belt. For many years it has been cut in the highlands of Tennessee, North Carolina, Kentucky, Virginia, and South Carolina. Some very fine dogwood can still be found in small quantities beneath loblolly pine on the Eastern Shore of Maryland. The exploitation of dogwood in Mississippi is more recent, as is its present importance in Florida.

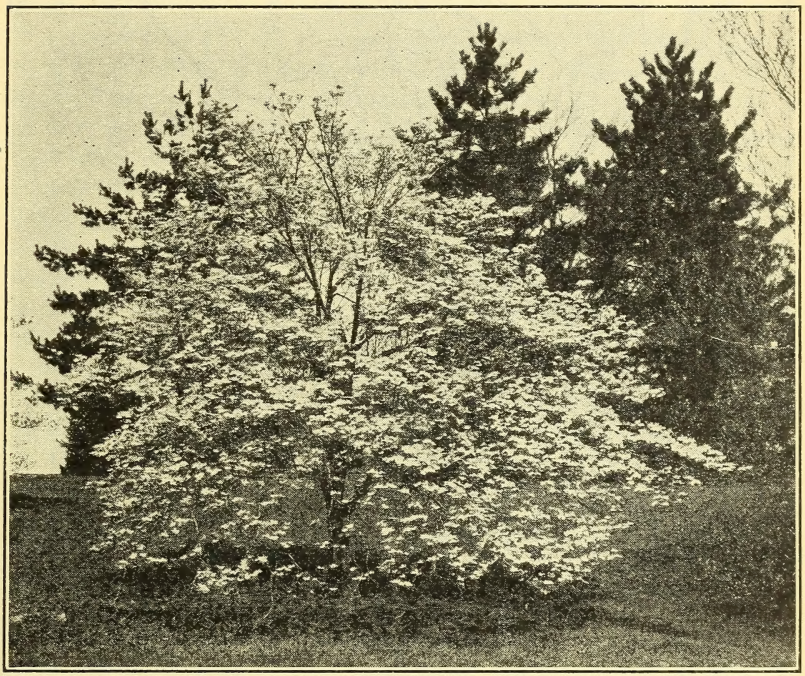

FIG. 1.—A beautiful specimen of flowering dogwood planted somewhat outside its natural range. (By courtesy of the Department of Parks, Rochester, N. Y.)

(Fig. 2.) The tree occurs generally as an understory scattered among larger hardwoods, or as an understory to the southern yellow pines. Seldom, if ever, is dogwood found in pure stands. At best it yields as much as 2 cords to the acre; but often 15 or 20 acres will produce no more than a cord.

The tree rarely reaches a height of 40 feet. It develops a short trunk 6 inches and more in diameter of which usually 4 to 8 feet is merchantable. (Fig. 3.) Although diameters occasionally reach 18 inches, this dimension is somewhat unusual.

The trunks, particularly of the older and larger trees, are seldom perfectly straight, and they are not often perfectly round in cross section. Trunks of older specimens are generally slightly bowed

or crooked and contain ridges. The bark of the young dogwood is composed of small quadrangular or many-sided red-brown scales, very characteristic of the genus. As the trees grow older the bark loses to some degree this distinguishing scalelike appearance; the scales with their quadrangular sides drop off, leaving the bark smoother and more flaky.

Users believe that wood from the lighter smooth-barked trees is inferior to wood from darker rough-barked trees. The fact that the former are generally older trees and therefore slower growing

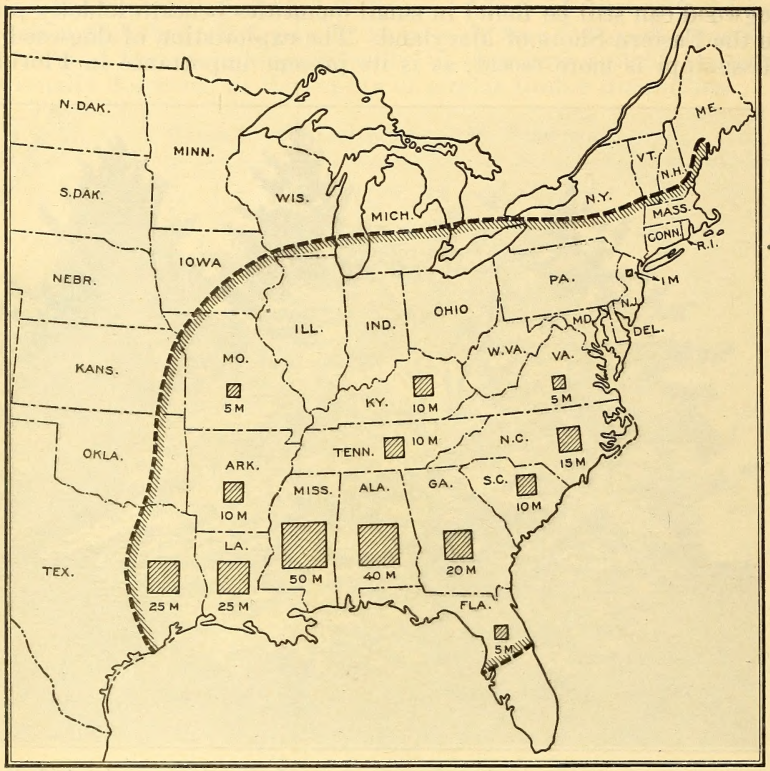

FIG. 2.—The natural range of flowering dogwood, with the estimated stand of commercially available timber in certain States expressed in cords. (M=1,000 cords)

under natural conditions may account for a difference in texture, but there is no apparent reason why the wood should be inferior.

Before quinine came into general use the root bark of native dogwood was one of the many barks used as a fever medicine. One manufacturer in the southern part of the United States says that his laborers when cutting dogwood do not suffer from malaria. The bark extract of both roots and stems is very bitter. Extracts from some dogwoods are said to be powerful narcotics and anodynes. Medical authorities in Edinburgh have employed an extract of the wood of one of the species native to Scotland in examinations of the

eye. When belladonna is used to enlarge the pupil the eye does not resume its normal condition for a period of 24 to 48 hours, whereas dogwood extract permits the eye to resume its normal condition in about 2 hours. Very small quantities of the root bark of the domestic dogwood are still used for medicinal purposes. About 15 tons of the so-called Jamaica dogwood (*Ichthyomethia piscipula*), which is found in the West Indies, particularly the Bahamas, and southern Florida, and is sometimes confused with our native dogwood, is used

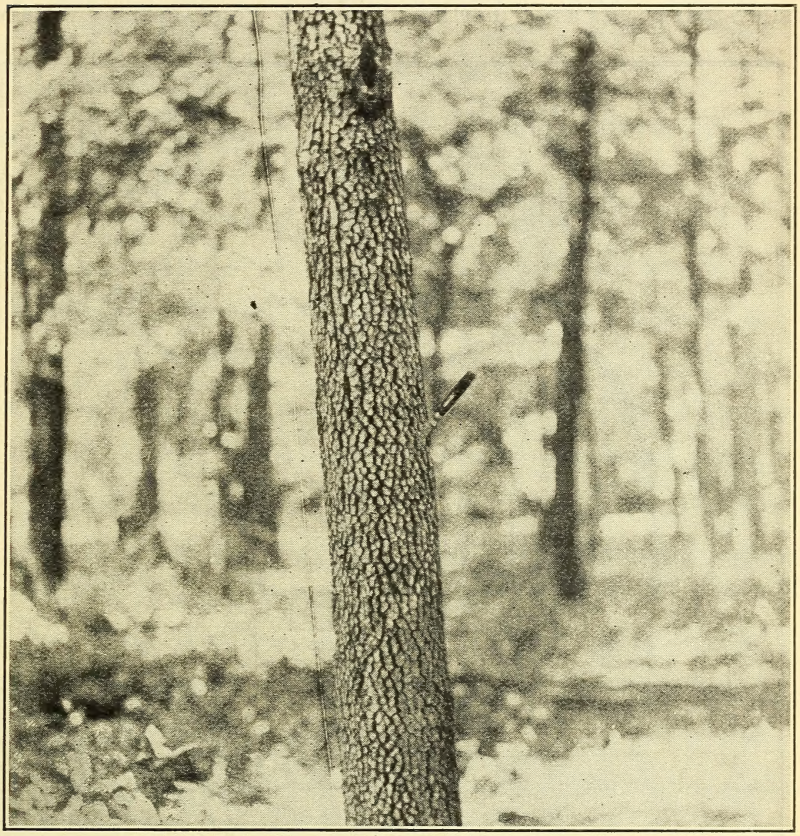

FIG. 3.—The trunk of a commercially valuable dogwood with characteristic bark—note defect at top

annually in the United States for medicinal purposes. The extract made from flowering dogwood roots was formerly used by Indians as a scarlet dye for blankets, feathers, and belts.

PERSIMMON

Of the 160 or more species of Diospyros only 2 are found in the United States, and only 1 of them is at present commercially important. This is the commonly called "persimmon tree," "date plum," "simmon," or "possumwood." It is also often called American ebony, because it happens to be a member of the ebony genus,

the species of which are chiefly tropical. The name "date plum" is supposed to have been adopted from the practice of the Virginia Indians, who dried the fruit and preserved it like dates. The generic name Diospyros comes from the Greek words "Dios" (the Greek god Zeus) and "puros" (wheat), which together may be interpreted "food for the gods."

The persimmon common to the eastern United States, *Diospyros virginiana* (fig. 4) is found on light sandy well-drained soil, or, in the Mississippi basin, on the deep rich bottom lands or river valleys. It occurs as far north as Five Mile Point, near New Haven,

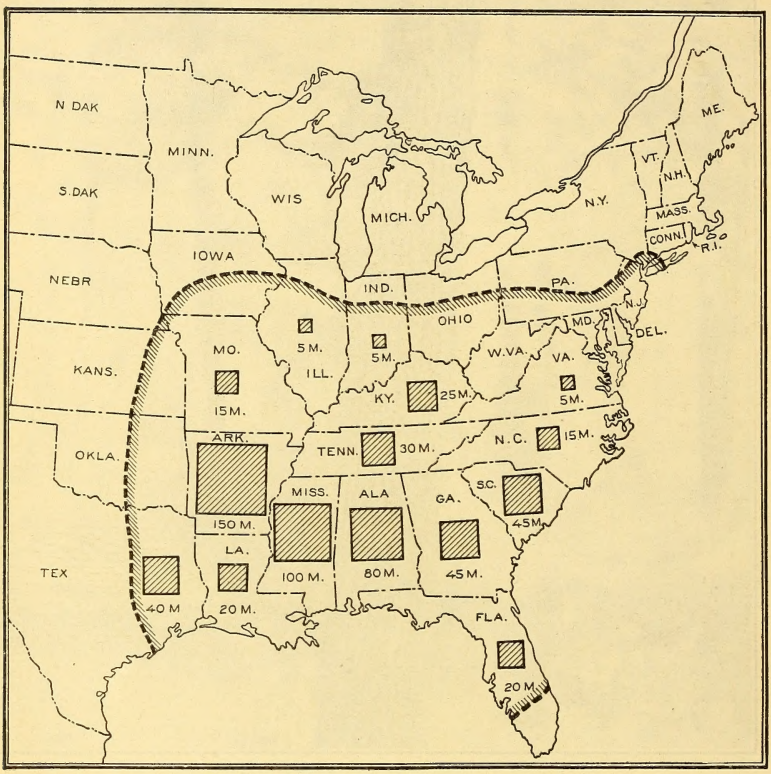

FIG. 4.—The natural range of persimmon, with the estimated stand of commercially available timber in certain States expressed in cords. (M=1,000 cords)

Conn., and is found on Long Island, N. Y. It ranges through southeastern Pennsylvania and southern Ohio, Indiana, and Illinois to southeastern Iowa, eastern Kansas, central Oklahoma, and southward to the Gulf and to De Soto County, Fla. It is very common in the South Atlantic and Gulf States, often covering abandoned fields with shrubby growth and springing up by the sides of roads and fences. It ascends the Appalachian Mountains sparingly to an altitude of 3,500 feet. Toward the western limits of its range it is rare. In Missouri, Arkansas, and eastern Kansas and Oklahoma occur several varieties of *D. virginiana*. There is also a

variety in Dade County, Fla. For commercial purposes a consideration of the varieties is not essential.

The chief commercial occurrence of persimmon is in the Piedmont and Coastal Plain regions from Virginia to Texas and in the lower Mississippi Valley lowlands. In mature or primeval forests it

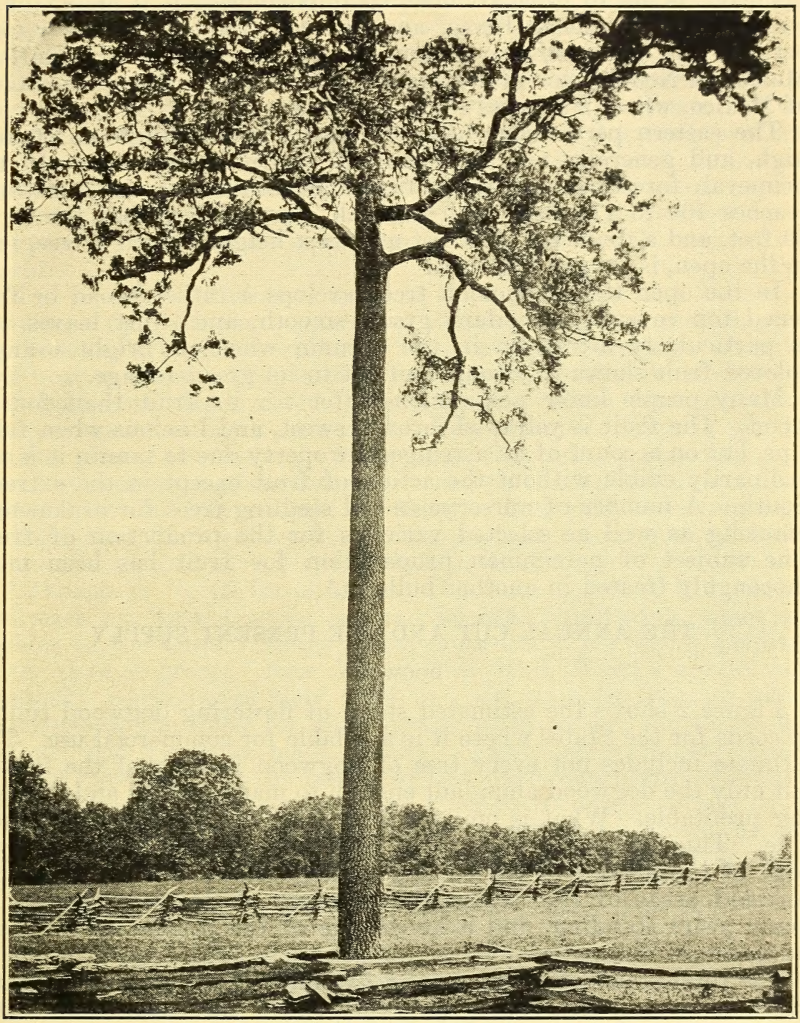

FIG. 5.—A fine specimen of persimmon tree 6 feet in circumference, Knox County, Ind.

occurs singly and widely scattered, for when crowded and shaded by larger species it can not survive as well as dogwood.

Although persimmon and dogwood are often found together, as, for example, in eastern Missouri and southern Illinois and Indiana, persimmon is a lowland or river bottom tree. It does not grow so well as dogwood in the Appalachian Mountain region, nor was it ever as abundant in the highlands of western North Carolina or South Carolina, or in the mountains of Tennessee, Kentucky, and

northern Georgia. Individual persimmon trees may be found on the uplands and in moist coves in the mountains, but the cost of removing them is not warranted.

The Mexican persimmon (*Diospyros texana*, Scheel) of Texas and Mexico, generally only 12 to 15 feet high and 4 to 7 inches in diameter, is not of great commercial importance. It is abundant in western and southern Texas, and is very common in the region between the Sierra Madre Mountains and the coast of the Gulf of Mexico in Neuvo Leon and Tamaulipas, the two northeastern States of Mexico, where it reaches its largest size.

The eastern persimmon (*D. virginiana*) is usually 30 to 50 feet high, and generally not more than 12 inches in diameter. In the primeval forest, under most favorable conditions, it sometimes reaches 100 to 115 feet, with a trunk clear of branches for 70 to 80 feet, and a diameter of 2 feet at breast height. Such a tree, rare in the open, is seen in Figure 5.

In the open the persimmon tree develops a rather broad or flattened top covered with dark green, smooth, and shiny leaves. It is particularly attractive in the autumn when its bright orange-colored fruit shows in strong contrast to its green foliage.

Many people know persimmon better for its fruit than for its wood. The fruit is yellowish brown, sweet, and luscious when fully ripe, but on account of an astringent property due to tannin it is not ordinarily edible without the action of frost except in the extreme South. A number of nurserymen sell seedling trees for ornamental planting as well as selected varieties for the production of fruit. The subject of persimmon propagation for fruit has been more thoroughly treated in another bulletin.[1]

THE ANNUAL CUT AND THE PRESENT SUPPLY

DOGWOOD

Figure 2 shows the estimated stand of flowering dogwood timber in cords for the States where it is available for commercial use. The estimate includes not every tree of dogwood in each of the States, but only the dogwood abundant enough to make cutting and marketing profitable. What is omitted is so scattered as to be unmarketable. This estimate is very rough and is based largely on a knowledge of the history of the cutting of dogwood, a knowledge of the forested areas of the States, the opinions of dogwood dealers of many years standing, and a knowledge of the present annual consumption of the material.

The total stand of commercially available dogwood in the States given is estimated to be 231,000 cords. On the basis of the 1923 consumption of 15,500 cords a year this would last approximately 15 years. As the demand for dogwood is increasing yearly, however, the remaining stands are likely to be cut over sooner, except as annual growth may prolong the period to some degree. Although it is impossible to state to what extent annual growth will offset annual cut, it may safely be said that the annual cut of the best of the commercially available dogwood exceeds the annual growth of the same kind of material.

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[1] FLETCHER, W. F. THE NATIVE PERSIMMON. U. S. Dept. Agr. Farm. Bul. 685, 25 pp., illus. October, 1915; revised September, 1923.

Of the 15,500 cords used in 1923, about 90 per cent, or 14,000 cords, was used for shuttle blocks. The remaining 1,500 cords was used for other products. As the average cord of dogwood will yield 400 shuttle blocks, the 14,000 cords represented a production of about 5,600,000 dogwood shuttle blocks. The year 1923 was, however, a year of higher than usual production. Ordinarily 3,500,000 to 4,500,000 dogwood blocks are produced annually. Reliable production figures for early years are not available.

Because dogwood has always been considered a minor species in the statistical work of the Forest Service and the Bureau of the Census, complete reports from all producers of dogwood products have never been obtained. Consequently, estimates of their production are more satisfactory than statistics derived from incomplete reports. It is perhaps safe to gauge the increase in production of dogwood by the increase in number of textile looms throughout the world.

Most of the shuttle-block mills in North Carolina and Tennessee have been there for many years, but dogwood bolts are now shipped to these mills from other States, because of the shortage of material near at hand. Only a few years ago dogwood in Mississippi and Louisiana was entirely ignored by the yellow pine operators, and was knocked down and uprooted by steam skidders in getting out the pine. At present in many areas they sell the standing dogwood to contractors who remove it before the yellow pine timber cutters and skidders get into the areas. Most pine operators have realized that dogwood is one of the highest priced native woods on the market and have found its sale profitable.

Although in North Carolina and Tennessee dogwood in commercial sizes has been heavily cut and is fast diminishing, there are regions in the United States where dogwood is not being cut over faster than it grows. New Jersey, Maryland, West Virginia, and Kentucky continue, as they have in past years, to furnish small quantities of the wood for mine sprags, mine rollers, shuttle blocks, mallets, and products made locally. These latter States, unfortunately, are north of the region of best development for dogwood, and can therefore never be counted upon to furnish a supply equal to the total demand. In Texas also, which is southwest of the region of best development, dogwood growth keeps pace with cut.

PERSIMMON

The estimated stand of persimmon timber, as shown in Figure 4 for the States where it is available for commercial use, totals 600,000 cords. This estimate, like that for dogwood, does not apply to all the standing trees, but to that timber which occurs in large enough size and in sufficient quantity to be worth cutting and marketing. Here, too, the estimate is rough and is based upon a knowledge of the history of cutting persimmon, a knowledge of the forested areas of the United States, the opinions of dealers of many years' standing, and a knowledge of the present annual consumption of persimmon. It is certain that more and more persimmon is being used each year in place of dogwood. The larger supply of the timber and the larger average size of the trees, with more clear material,

make it probable that persimmon timber will last longer than dogwood.

Of the 8,000 cords of persimmon consumed for dimension stock in 1923, 6,650 cords, or 83 per cent, was used in the manufacture of 2,600,000 shuttle blocks, and 17 per cent, or 1,350 cords, for golf club heads and shoe lasts.

In addition to dimension stock, approximately 25,000 board feet of persimmon lumber is produced annually. A few lumber companies have scattered on their holdings good-sized individual persimmon trees which they can profitably cut into lumber to be used for framework of vehicles. The use of persimmon lumber is limited by the difficulty of cutting it and because the heartwood, being streaky, does not match well. Several manufacturers of hardwood lumber cut the occasional persimmon logs into shuttle blocks for export.

A cut of persimmon lumber has been reported each year since 1907 by the United States Departments of Agriculture and Commerce. Companies in Arkansas have reported a cut practically every year. Companies in Mississippi and South Carolina have reported for about half the years, and companies in Georgia, Tennessee, Louisiana, Missouri, Alabama, Florida, and Illinois for a number of years. The reports are misleading in that the cut of small-dimension material has always been consolidated with the cut of persimmon lumber. One reading the lumber-production figures is led to believe that fairly large quantities of persimmon lumber were cut each year from 1907 to 1922 (the latest data available), when, as a matter of fact, the bulk of the cut reported went into squares or small-dimension stock for shuttles.

CUTTING AND MARKETING DOGWOOD AND PERSIMMON

A number of the farmers in the South who cut dogwood from their woodlands haul it to shuttle-block mills when the opportunity presents itself. Most of them, however, haul what they cut to a railroad siding, where one of the farmers, or more often a merchant, purchases it and lets it accumulate on the siding until a dogwood buyer comes and buys it. From the siding it is shipped to shuttle-block mills. (Fig. 6.) Very few shuttle-block manufacturers own their own dogwood timber.

A stand of 1 or 2 cords of commercial dogwood to an acre is considered extremely good. One cord on 1 to 10 acres is well worth cutting, and marketing, and even 1 cord to 15 acres in some localities. Less than a cord to 15 acres is hardly worth the handling under present economic conditions. The distance of the timber from the railroad and the difficulty of getting it cut and hauled determine, of course, the minimum quantity worth handling.

Manufacturers in 1924 were paying from $12 to $25 a cord for dogwood bolts delivered at the mill.

One owner of dogwood timber at Berea, Ky., refused in 1924 the following offer for material cut and stacked in the woods, claiming that it was too low:

Bolts, 60 inches long, per cord	$20
Bolts, 54 inches long, per cord	18
Bolts, 36 inches long, per cord	11
Bolts, 21 inches long, per cord	6

The offer read:

> Material must be above 4½ inches in diameter, straight, free from knots and defects, with not less than 2¼ inches of sapwood.

The price for bolts varies with the quality and size of material, and is generally not controlled by market quotations, but by the personal agreement of buyer and seller.

Cutting dogwood bolts in slack seasons offers farmers an opportunity to earn money in addition to the regular income from farm products. Farmers usually cut their fuel wood in the late fall, winter, and early spring, and in improving their woodlands by cutting out the weed trees, wolf trees, and less-valuable species will find it profitable to cut the merchantable dogwood, cord it, and carry it to a buyer when the opportunity presents itself.

FIG. 6.—Dogwood cut in Virginia for a dimension mill

A cord of dogwood is 4 feet high and 8 feet long, made up of bolts 4 to 5 feet in length. A cord is generally considered to weigh 4,800 pounds and to contain about 80 cubic feet of solid wood.

The production of persimmon differs considerably from that of dogwood in that lumber companies as well as farmers cut it. Persimmon lumber sold at the mill in 1924 for $35 per 1,000 feet, board measure. Persimmon logs were delivered to manufacturers in 1924 for $12 to $15 per 1,000 board feet, log scale, and persimmon bolts were delivered for $10 to $20 per cord. Prices for persimmon were as a rule lower than for dogwood.

THE WOOD

APPEARANCE

The average trunk of mature dogwood is composed mostly of sapwood, whereas in persimmon the sapwood may occasionally occupy

only one-half the volume of the trunk. The heartwood in either dogwood or persimmon may sometimes be as small as a lead pencil; then again it may be in dogwood 2 or 3 inches in diameter, and in a mature persimmon tree as much as 7 or 8 inches in diameter. (Fig. 7.)

The heartwood of dogwood varies in color from a reddish brown to a chocolate brown; the sapwood from pinkish to light brown. Persimmon sapwood when freshly cut is creamy white, although in the log the exuding sap gives the cross section a greenish-yellow appearance. When the sapwood of persimmon changes to heartwood it darkens and becomes streaky.

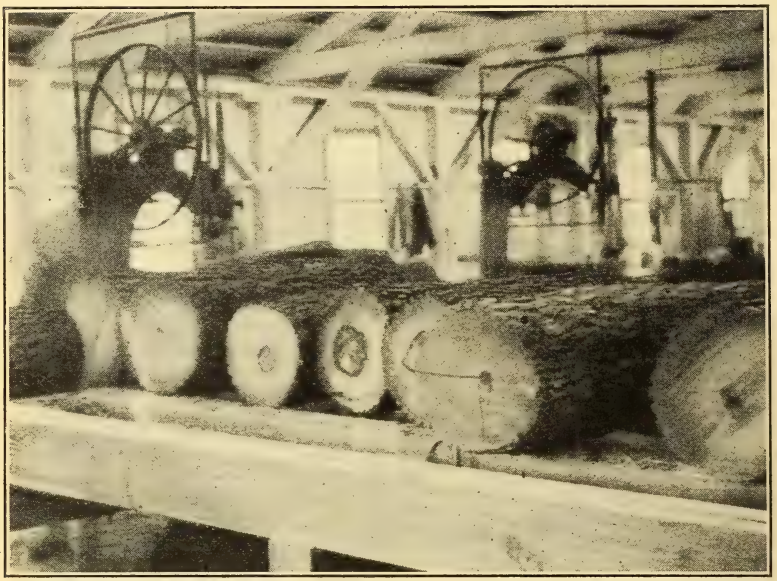


FIG. 7.—Persimmon bolts ready for the ripsaw. Note varying sizes of heartwood

STRUCTURE

As neither dogwood nor persimmon grows rapidly, the annual rings are usually narrow. Both are diffuse-porous woods. (Fig. 8.) In other words, the pores, or vessels through which the sap passes, are fairly uniform in size and are fairly evenly distributed throughout the annual growth ring. Although there is relatively little contrast between spring wood and summer wood, there is sufficient to differentiate the annual rings so that they can be seen with the naked eye. The summer wood of dogwood is slightly less porous and more orange colored than the spring wood.

The pores of persimmon, although not so numerous, are comparatively large, especially in the spring wood, decreasing somewhat toward the summer wood. Because of the greater size of the pores of persimmon and the comparative unevenness of their distribution the wood is not quite so uniform or fine textured as is dogwood.

In dogwood the rays, often called medullary rays, which serve for food conduction and storage, are not conspicuously broad, but on the smoothly cut end surface of the wood they can be seen distinctly as fine radial lines slightly lighter colored than the surrounding wood. In a cross section of a tree trunk rays may be compared to the spokes of a wheel. They vary in width, and the larger ones are somewhat wider than the largest pores, which ordinarily can not be seen with the naked eye. The rays of persimmon are very fine, even under a hand lens.

PHYSICAL AND MECHANICAL PROPERTIES

Dogwood and persimmon are very heavy, very hard, and only fairly straight grained. They are worked (cut, carved, shaped)

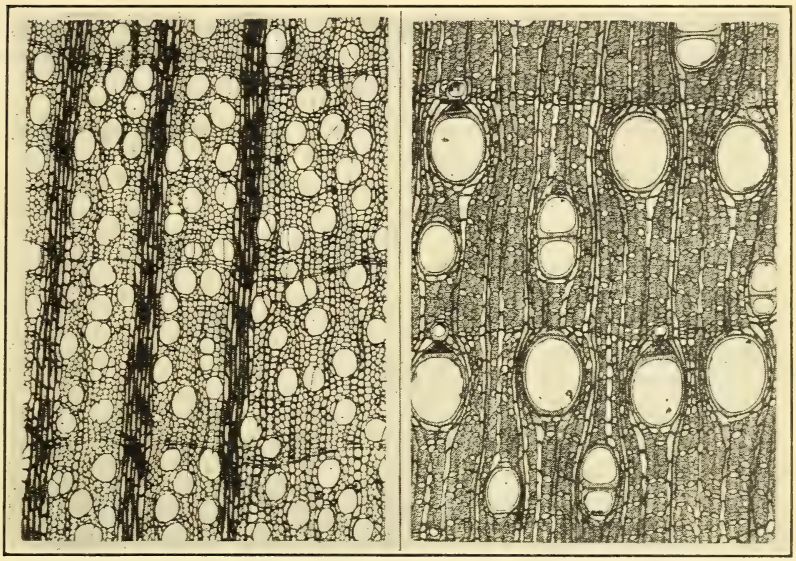


FIG. 8.—Cross sections of dogwood (left) and persimmon (right) magnified 38 diameters

only with difficulty, and they do not glue easily. The wood of each is tough and resistant to abrasion. Under continuous wear both become extremely smooth, although the dogwood being finer textured becomes the smoother of the two. The property of becoming extremely smooth is one of the most important in shuttles and makes dogwood and persimmon superior to such woods as hickory, oak, or maple for this purpose.

Dogwood squares of average shuttle-block size that contain the pith of the tree are liable to split or burst open during seasoning. This is caused by certain internal stresses that are set up in the wood as it dries. Pieces larger than shuttle blocks, such as those used for bobbin or spool heads, pulleys, and mallets, may contain the center or pith without danger of splitting. Bursting or checking is experienced with bolts as large as 4 to 8 inches in diameter in green condition if they are exposed to the hot sun, but this bursting does not

ordinarily occur in blocks over 3 inches thick or in bolts that have been shaded and carefully seasoned.

In a classification of native woods according to their physical and mechanical properties recently computed by the Forest Products Laboratory of the Forest Service, dogwood and persimmon are described as follows:

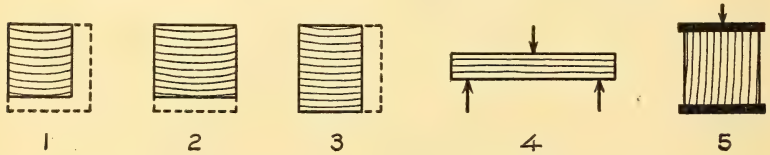
Property	Dogwood	Persimmon
Density or weight	Very heavy	Very heavy.
Strength as a beam or post	Strong	Very strong.
Hardness	Very hard	Very hard.
Shock-resisting ability	Very high	High.
Stiffness	Moderately limber	Stiff.
Shrinkage	Very, very large	Very large.

In Table 2 various properties of dogwood and persimmon are compared with those of white oak. The values were determined from standard tests made by the Forest Service.

TABLE 2.—*Actual and comparative properties of the wood of flowering dogwood and persimmon*

Properties	Dogwood	Persimmon
Locality where grown	Tennessee	Missouri
Weight per cubic foot:		
Green, pounds	65	63
Air-dry, do	54	53
Kiln-dry, do	52	51
Specific gravity, oven-dry, based on volume when green	0.64	0.64
Shrinkage from green to oven-dry condition:		
In volume (1), per cent	19.9	18.3
Radial (2), do	7.1	7.5
Tangential (3), do	11.3	10.8
Comparative shrinkage (twice volume plus radial plus tangential divided by 3), per cent	19.4	18.3
Strength in bending at 12 per cent moisture: (4)		
Modulus of rupture, pounds per sq. in.	15,300	18,100
Relative strength compared with white oak (white oak=100)	101	119
Strength in compression parallel to grain at 12 per cent moisture: (5)		
Maximum crushing strength, pounds per sq. in.	7,980	9,550
Relative strength compared with white oak (white oak=100)	107	129
Composite values:[1]		
Strength as a beam or post	10,300	12,295
Compared with white oak (white oak=100)	99	118
Hardness	1,427	1,501
Compared with white oak (white oak=100)	137	144
Shock-resisting ability	19.90	13.75
Compared with white oak (white oak=100)	154	106
Stiffness	1,205	1,668
Compared with white oak (white oak=100)	80	110

[1] Each of the composite values given in this table is a weighted average of several values derived from different kinds of strength tests. For instance, strength as a beam or post is a combination of values derived from tests in static bending, impact bending, and compression parallel to grain.



1=in volume; 2=radial; 3=tangential; 4=strength in bending; 5=strength in compression parallel to grain.

In Table 3 certain properties of dogwood are compared with those of hickory, white oak, persimmon, and the well-known eastern white pine. These values indicate that both dogwood and persimmon are rather difficult to kiln-dry, but that when once properly dried they rank high in ability to stay in place.

TABLE 3.—*Approximate comparison of certain properties of several species of wood* [1]

Species	Ease in kiln-drying	Ability to stay in place	Work-ability	Nail-holding ability	Ease with which wood can be glued
1	2	3	4	5	6
Dogwood, flowering	IV	I	III	I	V
Hickory, shagbark	III	II	III	I	IV
Oak, white	[2] III, IV	II	II	I	I
Persimmon	IV	I	II	I	IV
Pine, eastern white	I	I	I	IV	I

[1] Columns 2 and 4 represent a gradation of properties in the various woods from those which can be dried and worked with comparative ease (Class I), to those which present some difficulties in those respects (Class IV).

Column 3 represents a gradation from those woods which possess the greatest ability to stay in place under conditions of actual use (I), to those species which do not possess that ability to the same extent (II).

Column 5 represents a gradation from those which possess the greatest nail-holding power (I) but have the greatest tendency to split (which necessitates the use of smaller nails) to those having the least nail-holding ability, but which are less likely to split (IV).

In Column 6, woods in Class I are known to be used commercially in glued construction. Class IV includes woods which are known to present real difficulties in gluing, and Class V those species about which little is known but which it is believed would present some difficulties in view of their similarity to species of known properties.

These classifications are only approximate. They are not in every case based on the results of technical research but in some cases on observation, experience, and estimate.

[2] III refers to the upland type of oak, IV refers to the lowland type of oak.

SHUTTLE BLOCKS

MANUFACTURE

The use of dogwood and persimmon for shuttle blocks, which to-day accounts for at least 90 per cent of the dogwood produced and 83 per cent of the persimmon, apparently dates dack to 1865, when what was probably the first shipment of dogwood and persimmon logs cut in Virginia was sent to England. It is supposed but not definitely known that these logs were used for shuttle blocks. It has, however, been definitely established that about 1875 dogwood and persimmon logs cut in Virginia were made into shuttle blocks by a shuttle company in Lowell, Mass. This company cut the logs into blocks, seasoned the blocks, and then manufactured the shuttles. At present the manufacture of blocks is entirely separate and distinct from the manufacture of shuttles.

Up to 1880 Turkish boxwood was practically the only material used for shuttles. About that time, however, the roller-skating craze made such heavy demands upon this wood that it was necessary for the shuttle-block manufacturers to seek substitutes. The trial of dogwood and persimmon by the firm in Lowell was followed up by other manufacturers, and since 1880 the consumption of these two woods has gradually increased along with the increase in the number of looms in the textile industry, both in the United States and

in Europe, while the consumption of boxwood in the textile industry has dwindled to a very small proportion of the total.

Manufacturers of dogwood shuttle blocks use bolts that in the rough vary from 18 inches to 8 feet in length, and from 4 to 12 inches in diameter inside the bark at the small end. Bolts around 4 or 5 feet in length and 7 to 10 inches in diameter are the most desirable. Dogwood hauled by farmers direct to the mills is generally accepted in 8-foot lengths, but bolts shipped by freight are desired in 4 or 5 foot lengths, for these are loaded more easily in freight cars. Diameters above 10 inches are not particularly desired because the wood being older is more liable to be defective.

Some manufacturers believe that dogwood from the southern limits of its range is not so good as that from the northern limits, and that dogwood from Florida, southern Mississippi, and Alabama

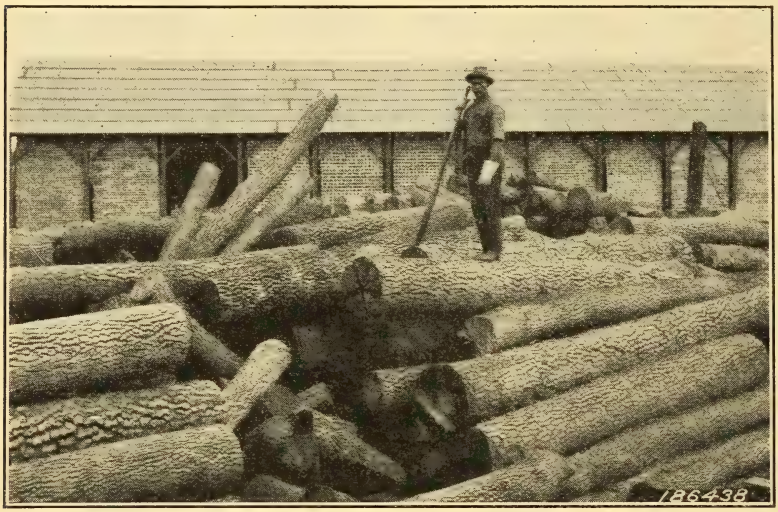


FIG. 9.—Persimmon logs delivered to a dimension mill. Dimension stock is seen stored in open sheds in the background

is not so desirable for shuttles as dogwood found farther north. Some believe that dogwood from certain sections of Tennessee is superior to dogwood from other sections of the State. There are no mechanical-test data on dogwood to prove any considerable difference, although the physical and mechanical properties of the wood vary to some degree with the conditions under which it grows.

Manufacturers of persimmon shuttle blocks use logs rather than bolts. (Fig. 9.) The logs range in size from 6 to 16 feet in length and from 6 to 20 inches in diameter. The larger logs are the more desirable, although they contain a higher percentage of heartwood than the smaller logs.

Manufacturers prefer dogwood and persimmon with a high percentage of sapwood in order to get clear, clean-looking blocks. There is, however, no apparent reason other than the mixture of colors for refusing blocks which contain both sapwood and heartwood. In

wood free from heart checks or other ordinary defects there is no difference in strength. The sapwood of the young tree in turning into heartwood has undergone only minor chemical changes, chiefly oxidation, which darken it to some degree, but do not weaken it. The cell structure is identical, and there is no reason why the wood should separate where heartwood and sapwood meet. Unnecessary waste results when blocks are refused because heartwood is present.

Most persimmon logs used by shuttle-block manufacturers are received by freight in gondolas or flat cars so that loading and unloading can be done readily.

At the block mill the bolts of rough dogwood and the persimmon logs are cut off by a circular saw to the desired length. Considerable skill is required of the cut-off man in obtaining the maximum amount

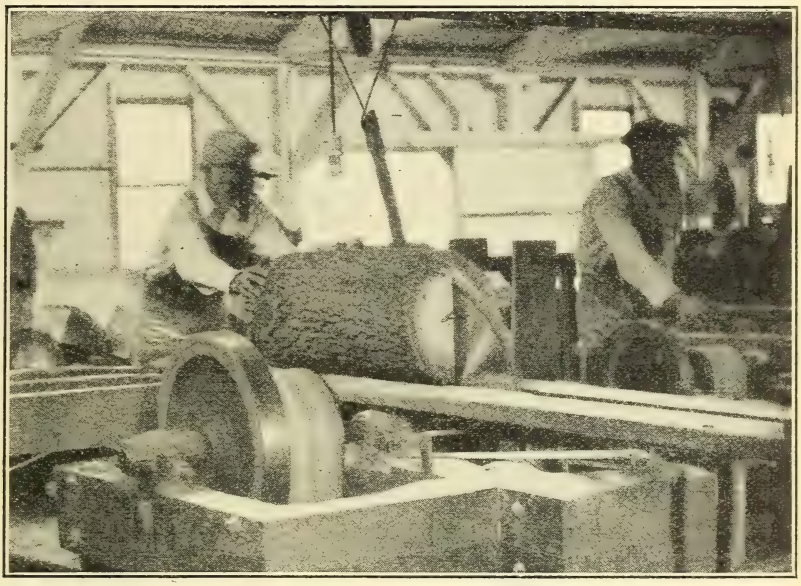


FIG. 10.—Ripping open the persimmon bolts

of suitable materials and eliminating waste. A skillful cut-off man will eliminate crooks, will allow only clear material in the same pieces, and will detect defects which the unskilled man can not see. Small bunched knots, very undesirable in shuttles, cause slight irregularities on the bark, resembling from the outside the knuckles of a man's fist. They are detected only upon close scrutiny. The section in which they appear is always eliminated in good manufacturing practice. An unskilled cut-off man in an effort to save material will overlook such defects and allow knots in the same piece with clear material. The whole piece must then be rejected when the knots are exposed by sawing.

Bolts for blocks after being reduced to the desired length are generally sawed open by either of two methods. Some manufacturers saw the bolts into halves first and then into quarters (fig. 10);

others saw off slabs in order to make flitches from which they cut the blocks. Blocks are usually wider than thick. They shrink with less distortion (warping, cupping, twisting, and diamonding) if

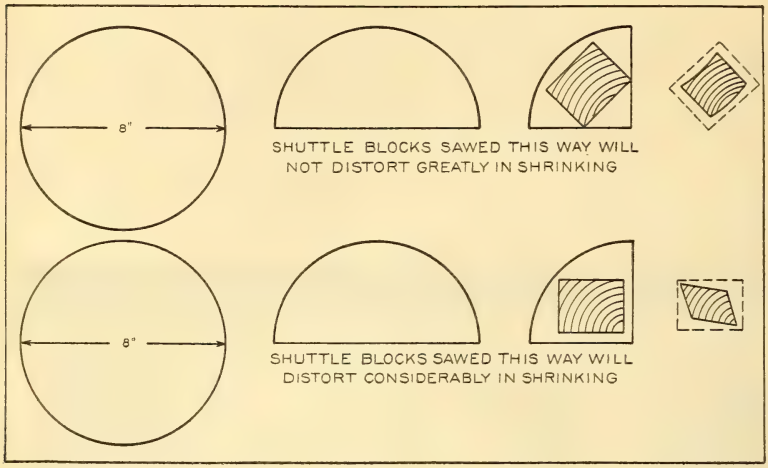

8"
SHUTTLE BLOCKS SAWED THIS WAY WILL NOT DISTORT GREATLY IN SHRINKING
8"
SHUTTLE BLOCKS SAWED THIS WAY WILL DISTORT CONSIDERABLY IN SHRINKING

FIG. 11.—Proper and improper methods of sawing out shuttle blocks

cut so that the top and bottom are parallel to the growth rings as seen on an end section (figs. 11 and 12). They are therefore much to be preferred to blocks with the growth rings on an end section at

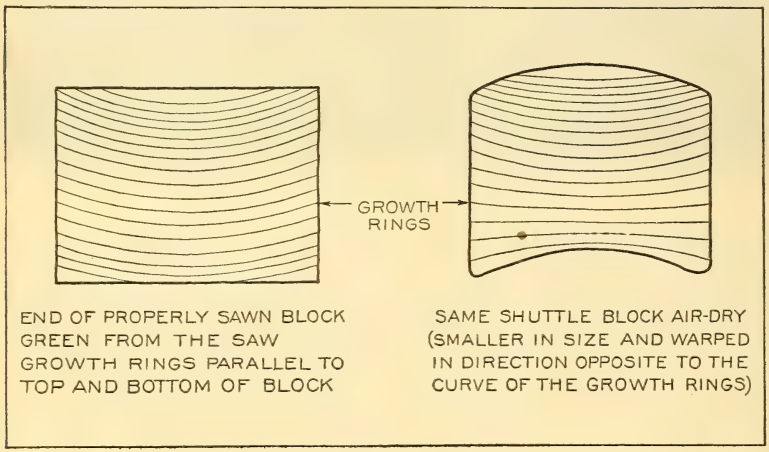

GROWTH RINGS
END OF PROPERLY SAWN BLOCK GREEN FROM THE SAW GROWTH RINGS PARALLEL TO TOP AND BOTTOM OF BLOCK
SAME SHUTTLE BLOCK AIR-DRY (SMALLER IN SIZE AND WARPED IN DIRECTION OPPOSITE TO THE CURVE OF THE GROWTH RINGS)

FIG. 12.—A properly sawn shuttle block before and after drying

an angle to the top and bottom. The block cut at an angle distorts more than the block cut parallel because the wood in a tree shrinks more along a line drawn tangent to the annual rings than it does along a line drawn perpendicular to them. (Fig. 11.) There is

not only shrinkage, but also considerable tendency to warp and twist in a block cut at an angle.

Block cutting, like bolt trimming, requires the highest degree of skill. A careful block cutter turns out 300 to 400 good shuttle blocks in a 10-hour day, but only men who have had a number of years' experience can cut the best blocks with a minimum of waste. The many small defects, principally knots and rotten streaks, found in the wood, together with the smallness of the dogwood bolts, make it a difficult matter to cut blocks that will meet specifications. The sides of every No. 1 shuttle block must be absolutely free of defects. (Fig. 13.) The top and bottom of a block may contain defects only if these occur in that part of the block which will be cut out when the

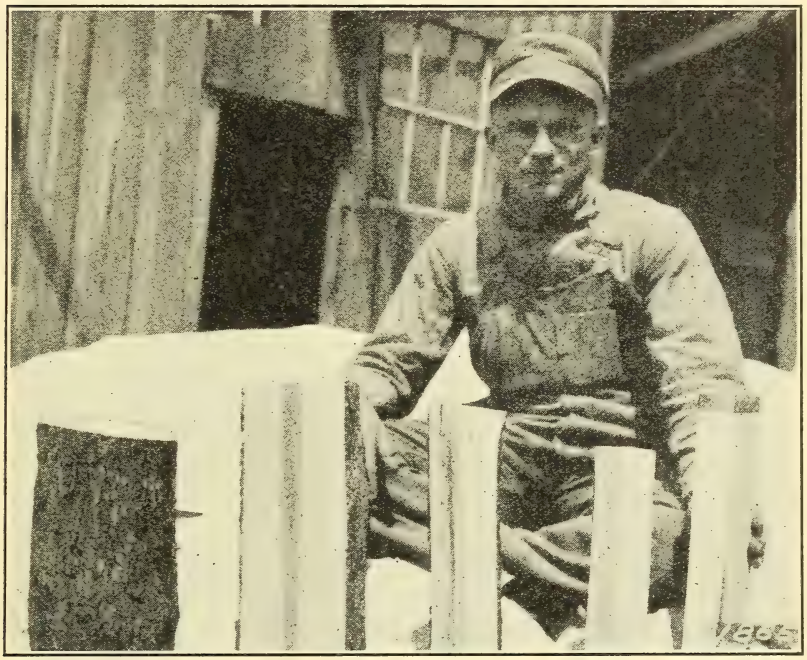


FIG. 13.—The stages in converting a dogwood bolt into a shuttle block

center of the block is removed and the ends are pointed. In dogwood hidden bark and knots cause tremendous waste.

The machinery used in the manufacture of shuttle blocks is very simple. It consists principally of circular saws, generally rotating parallel to one another on the same line-shaft. Electric power is most used, although steam, gasoline tractors, and even water power are employed. Figure 14 shows a layout for a shuttle-block mill. The building may be largely of the shed type where no flooring is required, as the bare ground soon becomes covered with sawdust, which keeps the footing dry and soft and warm in winter. Some very efficient shuttle-block mills are found in the most unpretentious buildings.

WASTE IN MANUFACTURE

In block cutting the waste accumulates so rapidly that special thought should be given to its removal from the saws. Chain conveyors, where possible, are far superior to wheelbarrows and are more economical. The material should be carried to a place where wagons and auto trucks can get at it readily. (Fig. 15.)

Most of the waste, made up of sawdust, slabs, edgings, and ends, is used for fuel. Dogwood and persimmon make splendid fuel wood. A cord of air-dry dogwood or persimmon of average size and quality will give the same amount of heat as a ton of bituminous coal of good grade. Such a cord contains about 80 cubic feet of solid wood and has a moisture content of from 15 to 20 per cent. In winter block manufacturers have no difficulty in disposing of their waste as fast as it accumulates, particularly if located in a town

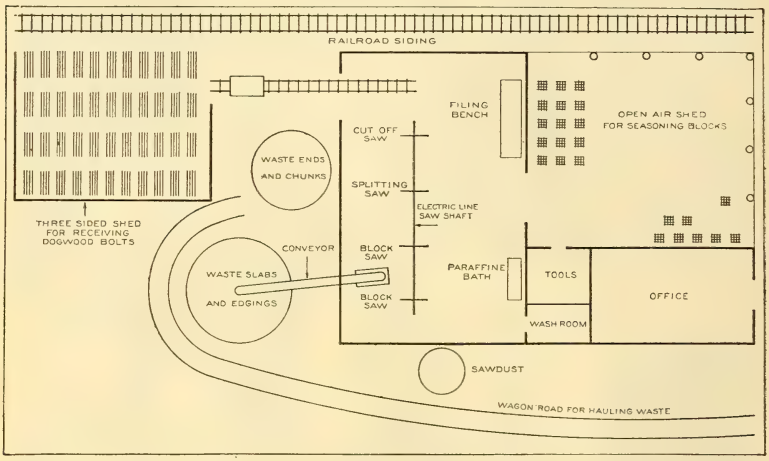


FIG. 14.—Plan of shuttle-block mill, illustrating a simple method of handling material in the manufacture and seasoning of blocks

where fuel is in constant demand. They obtain for it from 50 cents to $2 a cord.

Dimension material smaller than shuttle blocks is used for quills, flyer blocks, skewers, handles, jeweler's blocks, jeweler's sticks for cleaning deep-seated lenses, and similar articles. There are also a great many other small articles for which such heavy, dense, hard woods could be used to advantage. Dogwood and persimmon are particularly good for chisel handles, because they do not "broom" when hammered. They are also excellent for knife and fork handles and the backs of small high-grade brushes.

Manufacturers of dogwood and persimmon blocks may dispose of their discards and waste by making squares for handle manufacturers, provided orders are large and continuous enough to justify the expense. Although the cost of making small squares from waste is large, owing particularly to the necessary piling, seasoning, and other handling, the ever-mounting cost of dogwood and persimmon is favorable to such a means of closer utilization.

THE SEASONING OF SHUTTLE BLOCKS

AT THE SHUTTLE-BLOCK MILL

When the sawing of shuttle blocks is completed the ends are dipped into melted paraffin to prevent too rapid drying and checking. The blocks are then stacked in well-ventilated closed sheds or in open, roofed sheds with or without floors.

The care taken in stacking blocks varies with the manufacturer. It need hardly be said that careful stacking of green blocks is essential. To maintain the neatest and most rigid stacks it is well to stack the blocks so that the growth rings, as seen on the end sections, curve in the same direction throughout the stacks. Blocks are usually placed with their broader face down, one layer of blocks

FIG. 15.—Waste dogwood ends and sections sold for fuel

being laid at right angles to the other, the blocks in each layer being placed half an inch to an inch apart. (Fig. 16.) Sometimes in outdoor sheds in winter, to hasten the drying, two blocks are placed on their sides between layers. This type of stacking opens up each pile considerably.

The blocks are allowed to season from a few days to more than a year, depending upon the demand. The rate of air drying can be regulated to some degree through the manner of stacking. Seasoning proceeds more rapidly when the stacks are open-piled and placed far apart. In outdoor sheds the drying is generally more rapid in summer than in winter, although, of course, in buildings that can be heated, such as shuttle factories, drying is more rapid in winter.

Blocks dried out of doors will check more in summer than in winter, as will round bolts with the bark attached, particularly if exposed to the sun. The manufacturer who shields his raw material from rains and the hot sun of summer with an inexpensive but waterproof shed shows good judgment. Some manufacturers, in order to avoid seasoning difficulties and fungous infection in both bolts and blocks, do not cut their dogwood and persimmon dimension stock in the summer months. This is very good practice when possible.

Two by two inch shuttle blocks having in their green state a moisture content of from 25 to over 100 per cent of the oven-dry weight of the wood require about nine months of open-air seasoning to become what is ordinarily known as air-dry; that is, to come into equilibrium with the surrounding atmosphere, averaging between 12 and 15 per cent in moisture content.

If all blocks were so uniformly seasoned as to be air-dry when shipped the shuttle manufacturer's problem of utilization would be comparatively simple. The block manufacturer endeavors to season his blocks as long and as uniformly as possible, but is often compelled because of rush orders for odd sizes which are not in stock to ship blocks some of which are practically green, or half air-dried.

Several block manufacturers interested particularly in the export trade hold large quantities of blocks in storage houses near ports, where the blocks have opportunity to air season properly.

AT THE SHUTTLE FACTORY

The shuttle manufacturer seldom knows the condition of the blocks that he receives and frequently makes no careful effort to find out. To avoid waste and unnecessary loss, however, he should determine at once the moisture content of the incoming blocks so as to know exactly how they can best be treated and what course of seasoning they need.

Most manufacturers are content to pile the blocks in an open shed or in some sort of seasoning room for a long period of time to be sure that when used the blocks will have reached an equilibrium in moisture content. This would be very good practice if the manufacturer did not soon find himself tied up with thousands of dollars' worth of raw material unready for use. The inventory of one modest shuttle factory on December 31, 1923, showed $86,000 worth of dogwood and persimmon blocks in the process of seasoning, not representing excess purchases during the World War but purchases in the ordinary run of business. In such a system of seasoning not only is capital tied up in the cost of the blocks, but also there is expense in the handling and rehandling of them, in the storage sheds and buildings required, and in the ground space the buildings occupy.

The remedy for this is artificial seasoning or kiln-drying. Well-regulated kilns thoroughly understood by the operator will help to solve a problem which unquestionably is one of the most vexing in the manufacture of shuttles. Several manufacturers are already successfully kiln-drying shuttle blocks in much less time and with much greater satisfaction than with the long-time air seasoning. Some are using heated chambers, either with or without forced

draft; others are using kilns in which the humidity, the temperature, and the circulation of air can be in some measure controlled. Those factories where the control of humidity, temperature, circulation of air, or all three, is being attempted obtain the best results. Complete success is only possible through a thorough understanding of the principles of kiln-drying.

The drying of green wood to 25 per cent moisture content is rather a simple matter; the drying from 25 per cent to 7 per cent is somewhat more difficult, but can be done by an operator who has a good understanding of the seasoning of wood.[2]

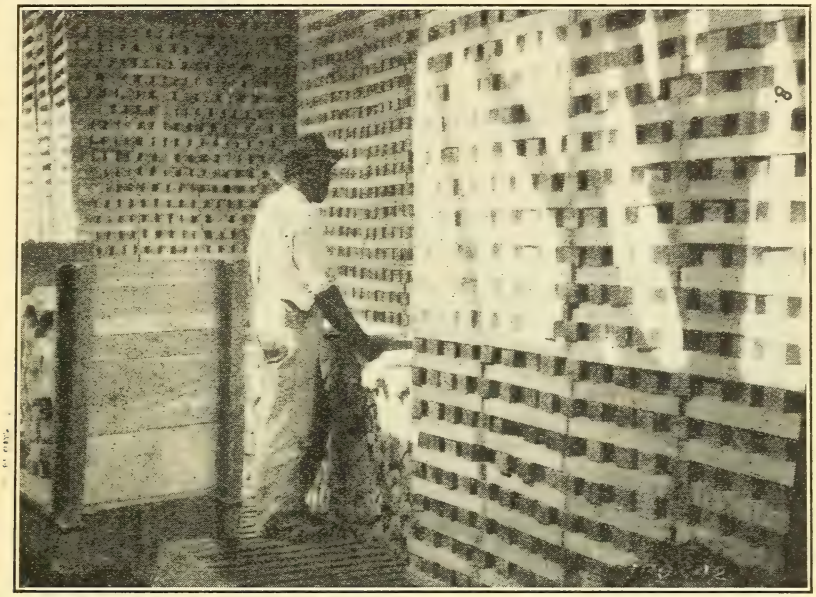


FIG. 16.—Stacking dogwood blocks in an open-air shed for seasoning

Experimental work in commercial-sized condenser kilns at the Forest Products Laboratory, Madison, Wis., in seasoning solid round sticks or stems of perfectly green dogwood up to 3⅛ inches in diameter showed that they could be dried without checking in 65 to 70 days, moisture content being reduced from 85 per cent to 10 per cent of the oven-dry weight of the wood. In a well-regulated condenser kiln green shuttle blocks 2 by 2 by 18 inches can probably be dried from the green condition, say, 85 per cent moisture, to 7 or 8 per cent in 50 to 60 days. Shuttle blocks 2 by 2 inches previously dried to 15 per cent in the air can be kiln-dried to 7 per cent in 12 days.

Wood dried to a low moisture content, such as 7 or 8 per cent, because of the high temperatures used may lose to some degree its ability to reabsorb moisture. By drying shuttle blocks to 7 per cent or lower, therefore, the tendency to subsequent swelling, twisting, and warping due to reabsorption is lessened.

[2] An excellent manual for the operator who wishes to study this subject is Kiln Drying Handbook, by Rolf Thelen, U. S. Dept. Agr. Bul. 1136. 64 pp. 1923.

The actual process of kiln-drying should start with a high humidity and low temperature, and should end with a lower humidity and a higher temperature. Steam should be admitted at the beginning of the run to heat the blocks through and to moisten them to some degree so that the moisture in the interior of the blocks will move to the surface more rapidly and more easily. Steam may also be necessary during the run to reestablish within the blocks the uniform flow of moisture which may be broken in the process of drying by the tendency of the blocks to caseharden. Adequate circulation through the spaces between the blocks and away from the blocks is at all times necessary. The flow of air within the kiln should be studied during a run by tracer currents of smoke.

In order to understand what is taking place within the blocks themselves as the drying proceeds, tests for casehardening and checking should be made by sawing open the blocks used for test samples. Test should be made periodically to determine the moisture content of the blocks.

The five steps necessary to make a moisture determination are:

1. Cut a sample from the center of the material.
2. Immediately after sawing, remove all loose splinters and weigh the sample.
3. Put the sample in an oven maintained at a temperature of 212° F., until constant weight is attained.
4. Reweigh the sample to obtain the oven-dry weight.
5. Divide the loss in weight by the oven-dry weight and multiply the result by 100 to get the percentage of moisture in the original sample.

$$\text{Percentage of moisture} = \frac{(W-D)}{D} \times 100$$

Where

W=Original weight as found under 2 above.
D =Oven-dry weight as found under 4 above.

Another method used for determining the amount of moisture in chips requires little equipment and only 7 to 10 minutes time.

A specified weight of wood chips taken from shuttle blocks, usually 100 grams, is immersed in kerosene in a flask or retort and the mixture is heated. The water in the chips changes to steam at 212° F., and goes out through a glass tube in the cork of the flask, is condensed by a water jacket surrounding the tube, and caught in a measuring glass. The boiling point of kerosene being higher than that of water, all the moisture will be driven off the chips before the oil vaporizes to any great extent. The oil that does go off in the form of vapor is condensed and caught in the same graduate with the water. When the evaporation of moisture is complete the oil and water are allowed to remain a few minutes until the water has all settled to the bottom of the graduate. The amount of moisture in the wood chips is then found by a direct reading.

This method has been checked for accuracy with that of weighing samples before and after oven-drying, and the variation found to be less than 1 per cent.

One of the big weaknesses in kiln-drying at shuttle factories is an inadequate and irregular supply of steam for heating the dry kilns. In some factories the steam pressure at night is not maintained, and the continuity of drying is consequently broken. The

drying of blocks under these conditions is very unsatisfactory. The largest economies in shuttle making may be attained by proper handling of the raw material, the shuttle blocks.

EXPORT OF SHUTTLE BLOCKS

Of the 5,000,000 to 7,000,000 dogwood and persimmon shuttle blocks produced annually, it is estimated that about three-fifths are exported. Most of the smaller-sized shuttle blocks of dogwood and the larger-sized blocks of persimmon are exported. The larger-sized dogwood blocks and the smaller-sized persimmon blocks are made into shuttles for domestic use.

Blocks for export are generally packed tightly in burlap bags, the number per bag depending upon the size of the blocks. One

FIG. 17.—Shuttle blocks packed in bags for export

concern packs one hundred and forty-four 15-inch blocks in a bag. (Fig. 17.)

Blocks are exported chiefly to Great Britain, France, and Germany. Lesser quantities are exported to Italy and Switzerland. Shipments are made from New Orleans, New York, Mobile, and Jacksonville. Thirty-five years ago, when the center of the block industry was nearer the Middle Atlantic coast, the chief exporting point for shuttle blocks was Norfolk, Va. The dogwood and persimmon in Alabama, Mississippi, and Louisiana had then hardly been touched.

The first shipments of dogwood and persimmon to British manufacturers in 1865 were in the round, but this was not long continued as a general practice, for it was soon found to be more economical to export the manufactured blocks, thus saving cargo space, cost in handling, and freight on bark, slabs, edgings, and defective mate-

rial. Shipments of persimmon logs 8 inches and up in diameter and over 8 feet long continued for some time, but since 1900 persimmon, like dogwood, has been shipped in shuttle-block form only.

SHUTTLES

The shuttle discussed in this report is the device used in textile looms to carry the weft thread or filling to and fro between the warp threads or chain. It is a development of the old hand-loom shuttle, which was thrown with one hand and caught with the other. Not much wear and tear occurred in the hand loom, and almost any wood was satisfactory. In the textile industry of to-day, however, the shuttle is shot forcibly back and forth across the loom at a very high speed, in continual contact with the taut threads of the warp. It is evident that the slightest tendency of the wood to roughen or check would render the shuttle worse than useless.

MANUFACTURE

Approximately 2,000,000 shuttles were made in the United States in 1923, about 78 per cent of dogwood, 21 per cent of persimmon, and less than 1 per cent of boxwood.

Manufacturers of shuttles complain that each year they experience more difficulty in obtaining perfect shuttle blocks, particularly dogwood blocks, and that the percentage of knots in the blocks they receive is higher now than formerly, regardless of whether they order perfect No. 1 blocks. This is easily explained. More and more dogwood timber has matured on areas cut over for other timber. Growing in the open the trees retain their limbs longer and the wood consequently produces more knots than timber matured on areas untouched by the ax. These defects are often hidden within the block and do not appear until the shuttle is being made, when boring, turning, and trimming reveal them.

Most of the shuttles made in the United States are manufactured in Massachusetts and Rhode Island. Some are manufactured in New Jersey, more especially the boxwood shuttles for silk mills. The silk industry requires a smaller and finer shuttle capable of attaining an exceptionally smooth finish. Although a number of dogwood shuttles are used, boxwood because of its extreme smoothness and clean appearance, even though higher priced, is especially appealing to broad silk manufacturers.

For some 10 to 15 years shuttles covered with hard fiber have also been manufactured, for use in the silk industry principally. Sheet fiber is glued to the outside of dogwood and persimmon. Some who have used this combination and prefer the all-dogwood shuttle report that under humid conditions the glue of the fiber-covered shuttle is likely to soften so that the fiber and wood separate. Some users dislike the fiber-covered shuttle because it is said to wear the metal reeds of the loom more rapidly than the all-dogwood shuttle. The rounded edges of the reeds are said to become angular more quickly, and the fine thread unwinding itself from the quill or bobbin catches on the rough edges and causes an interruption in the operation of the loom.

Shuttle makers in the United States report that shuttle blocks cost them from 12 cents apiece at point of origin for the smallest size to $1.25 for the largest size. Others who buy blocks on the basis of

contents in board feet pay from 35 to 75 cents a board foot, again in accordance with size.

The average board foot contents of shuttle blocks from 12½ to 16½ inches in length, carried in stock by one manufacturer, was three-tenths of a board foot, and of shuttle blocks from 17½ to 30 inches, 1¼ board feet. Two-fifths of a board foot is the figure generally used in computing. This represents an average block slightly smaller than 2 by 2 by 16 inches.

The actual process of making shuttles starts with the selection of blocks which have been carefully kiln-dried to a moisture content of 5 to 8 per cent. The rough blocks, which have been somewhat distorted in shrinking, are surfaced on all sides. The surfaced blocks

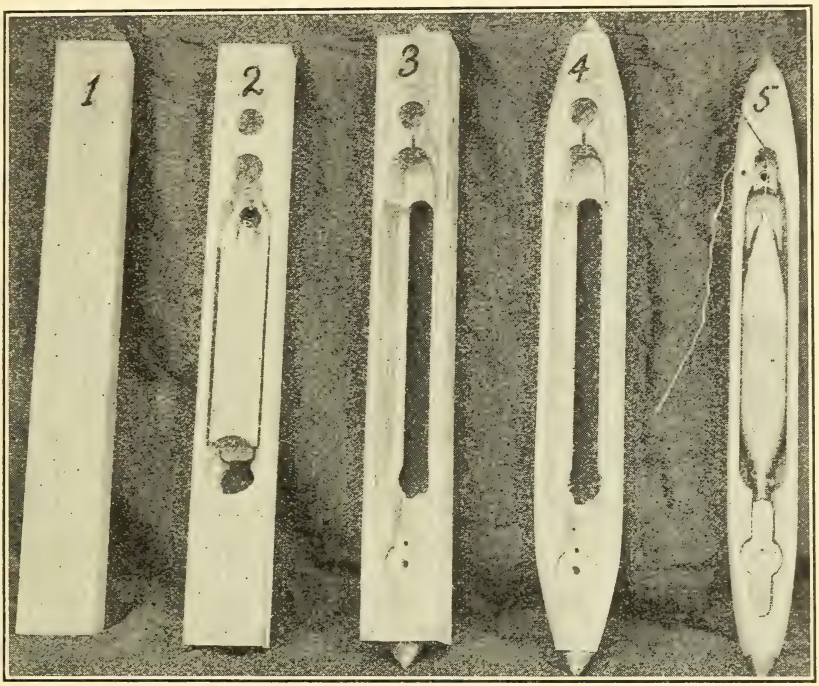


FIG. 18.—Stages in the manufacture of a shuttle (15 inches in length). Nos. 1 to 4, persimmon; No. 5, dogwood

then go through a number of boring, turning, and trimming processes before the necessary metal parts are inserted. (Fig. 18.) Before final finishing they are dipped to make them somewhat moisture-resistant, usually either for a short period in hot linseed oil, or over night in cold linseed oil.

Most manufacturers have encountered at some time or other during the process of manufacturing shuttles a tendency of the wood to check, owing to a change in atmospheric conditions, loss of moisture within the block, and consequent shrinkage. Linseed oil, often used in such emergency cases, is partially successful in reducing the rapidity of moisture loss. It must be stated, however, that for permanently preventing the loss or gain of moisture by the shuttle, linseed

oil is not very effective. It is far from being the good moisture-resistant coating or filling that many manufacturers believe it to be.

The shuttle industry needs an impregnating material more resistant than linseed oil to the passage of moisture. The humidity in textile mills varies considerably, causing much swelling and shrinking of the wood in the shuttles. As a result the manufacturer can never feel confident that shuttles will function properly in the loom. An effective impregnating material will materially better this condition.

In Germany shuttles have recently been manufactured from such common German woods as beech, birch, and pine impregnated with hot liquid asphalt or paraffin compounds. These woods in their natural state do not make good shuttles, but the impregnation process is said to make them susceptible of a high finish. Though the work is still in more or less of an experimental stage, one concern claims to have sold several thousand shuttles made of the woods so impregnated. This firm has circulated literature illustrated with pictures of the treated shuttles. The possibility of successfully impregnating other woods so as to make them as resistant to wear as dogwood and persimmon and at the same time moisture resistant should be given consideration by American manufacturers.

GLUING SHUTTLES

In column 6 of Table 3 is shown the relative difficulty of gluing dogwood as compared with several other woods. Manufacturers of combination fiber and dogwood shuttles who glue a fiber covering to a dogwood core often encounter difficulty, owing in part to the hardness and density of the wood. Extreme care in the gluing operation is necessary to insure satisfactory results.

The first requirement in gluing difficult woods with animal glue is a good grade of glue properly prepared. The glue solution should not be heated above 140° or 145° F. or kept hot longer than necessary. Fresh glue should be mixed every day or oftener and glue pots and brushes kept clean.

It is important in gluing difficult woods to have the glue at the right consistency at the moment pressure is applied. It should not be so thin that practically all of it squeezes out of the joint when pressed, nor so thick or dry that the two faces of the joint will not come together under the pressure used.

The consistency of the glue is governed mainly by the combined effect of the temperature of the wood and the glue room, the quantity of glue spread, and the length of time between spreading the glue and pressing. If gluing conditions are such that pressure must be applied while the glue is very thin, very light pressures such as 25 to 50 pounds per square inch must be used. If a long time elapses between spreading and pressing and the glue becomes very thick, pressures as high as 400 to 600 pounds per square inch may be required. Under average good conditions a pressure of about 200 pounds per square inch should give good results. Further information about gluing requirements may be obtained from the Forest Products Laboratory, Madison Wis.

When shuttles made with animal glue are used under very humid conditions. the glue is likely to soften and allow the joints to open.

Where experience has shown that this occurs, water-resistant casein glues may be used. Good casein glues have high strength and will successfully resist dampness for a long time. They are, however, usually harder than animal glue and are liable to cause trouble by dulling the knives of wood-working machines in the shuttle factory.

WASTE IN MANUFACTURE

In order to manufacture 1,989,000 dogwood and persimmon shuttles for domestic use in 1923, it was necessary to purchase 2,245,000 shuttle blocks. This loss of 256,000 blocks, or 11 per cent, represents the discards thrown out because of defects developed in seasoning or revealed in making the shuttles.

The loss was higher in dogwood blocks than in persimmon blocks, because of the more defective character of dogwood. From 1,790,000 dogwood blocks 1,556,000 shuttles were made, with a loss of approximately 13 per cent, while from 455,000 persimmon blocks 433,000 shuttles were made, with a loss of less than 5 per cent.

In the manufacture of approximately 11,000 boxwood shuttles from thick boxwood lumber, the percentage of waste was greater than in dogwood.

The shuttle manufacturer finds it difficult to sell his accumulation of waste blocks, although they are generally uniform in size, well seasoned, and available for quick shipment. Manufacturers of small wood products such as chisel, awl, and knife handles, requiring strong, hard, and dense woods, will find shuttle manufacturers glad to dispose of this material rather than to burn it for fuel. It is generally more uniform in size and better seasoned than the waste which accumulates at the rough block mills in the South and is in excellent condition for the articles mentioned.

The high loss of shuttle blocks in the manufacture of shuttles is not altogether necessary. Certain users of shuttles demand that the wood in the shuttles they order be absolutely perfect. They will not permit the slightest defect in the wood of the completed shuttle, regardless of whether that defect will cause loom interruptions or not. Small knots present in some parts of the finished shuttle where they would cause no interruptions are not admitted. Shuttle users who appreciate more the increasing scarcity of good dogwood will not demand a shuttle the wood of which is absolutely perfect, when the defects are so small as not in any way to hinder the proper operation of the shuttle.

PRODUCTS OTHER THAN SHUTTLES

SPOOL AND BOBBIN HEADS

The heads of many thousands of spools and bobbins (fig. 19) are made of dogwood. The barrels of spools are generally made of less expensive materials, such as beech, birch, and maple. For the heads of spools and bobbins, however, which are liable to split and break when dropped, no other native wood is superior to dogwood.

In making heads for spools and bobbins, the ends of the rough dogwood bolts are sawed off, the thickness depending upon the thickness of the desired head and the diameter upon the size of the material available. The sections cut off are then turned individually

on a lathe to the desired rough-finished diameter. These green rough-finished heads require careful handling in order to minimize checking and splitting. They are piled loosely on the floor in open sheds, all of one size together, and covered with burlap sacks to prevent too rapid loss of moisture. The burlap sacks are removed about once a week, according to weather conditions, and the blanks are turned over by means of a shovel so that the drying-out process may be more even. The burlap sacks are then replaced. The process is continued for two or three months until the danger from severe checking has passed. The blanks are then shipped in bags to spool and bobbin manufacturers.

Spool and bobbin heads manufactured in the rough are 1½ to 4 inches in diameter, and one-half inch to 1¼ inches thick. The average price is $6 to $8 per thousand pieces.

In the bobbin and spool industry there is at present a tendency to substitute fiber for wooden heads. Fiber is very satisfactory for heads and may ultimately replace a large part of the many kinds of wood now so employed. Dogwood for heads will, however, continue to be employed for some time.

PULLEYS

Small pulleys (fig. 19) made of dogwood are strong and light and are very serviceable in the textile industry. The blanks from which they are shaped are cut in about the same manner as the heads for spools and bobbins, and the pulleys are finished, dressed, and sanded on lathes. Only a small quantity of dogwood is used for pulleys.

SKEWERS

A skewer is a bobbin spindle the blunt end of which is fixed to the horizontal member of a creel or frame on a spinning machine. The smalls tips of skewers, approximately only one-fiftieth of the volume of the whole skewer, are often made of dogwood. Tips of dogwood resist wear so much better than beech, birch, and maple, of which the body of the skewer may be made, that they find a very important use, although only a very small quantity of wood is employed.

MALLET HEADS

Dogwood, because it resists continual pounding and hammering without chipping, breaking, denting, brooming, and splitting to the same degree as other woods, is used for the better grades of tinsmith mallet heads (fig. 19). The uniform fineness of dogwood and its pink and brown coloring make it very attractive for this purpose.

Mallet heads are turned on a lathe from rough dogwood bolts with the bark on. When turned on the lathe the bolts should be as dry as the mallet would eventually become in ordinary use. It is, of course, more difficult to turn rough dogwood bolts when dry than when green, but if the bolt is turned when green there is always considerable loss through checking of the mallet head itself in drying. The center or pith need not be eliminated in bolts used for mallet heads. As a matter of fact, it would be an extremely difficult task to saw the head of a tinner's mallet out of the sapwood alone

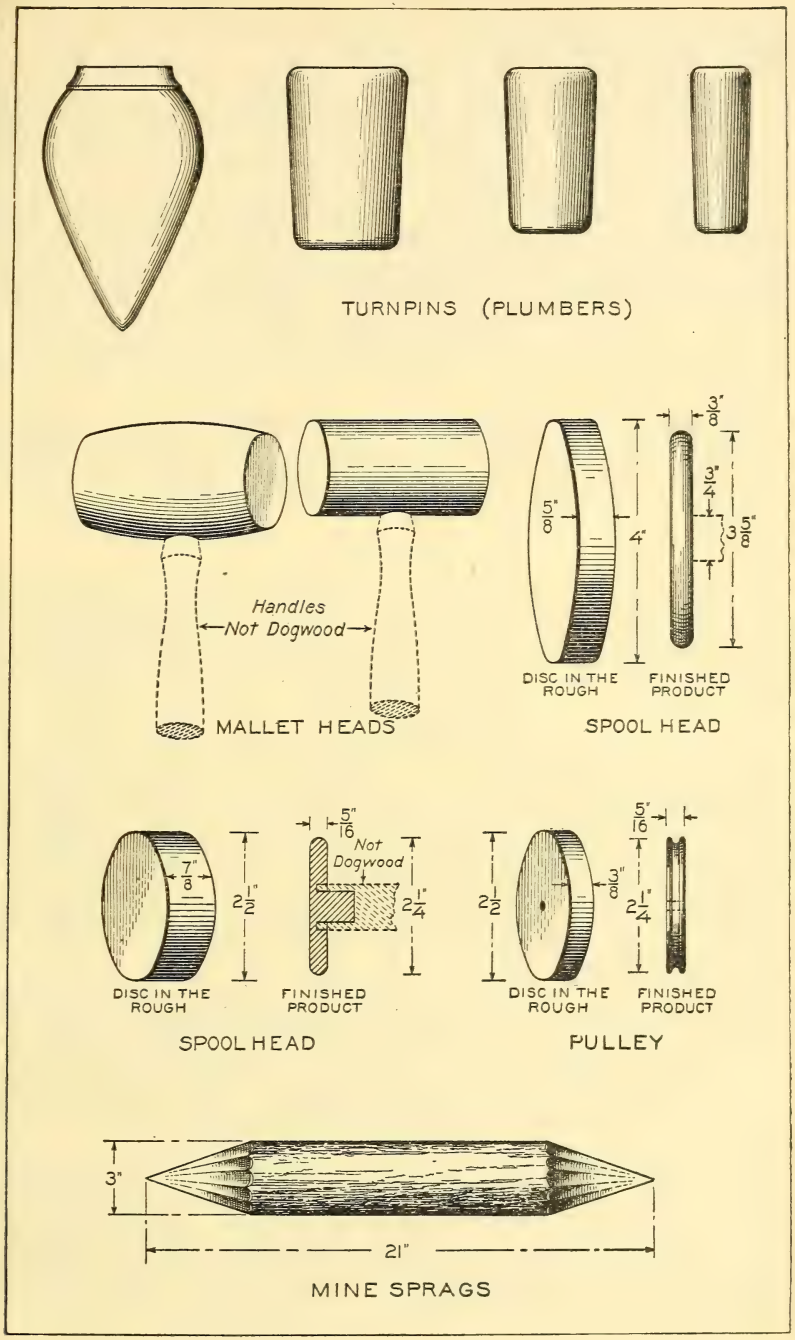


FIG. 19.—Products made from rough dogwood bolts by turning

from the dogwood trees available to-day. Unlike shuttle blocks, properly cared for bolts of this kind are large enough to resist the internal stresses which cause bursting.

The shape of mallet heads varies. The two shown in Figure 19 are well-balanced heads, the one barrel-shaped, and the other cylindrical, both with beveled edges to prevent brooming. After being turned to the proper size the heads are sanded to a fine finish and the hole for the handle is bored.

Boring is often the test of careful and uniform seasoning. If the seasoning has been so conducted that drying is only partially effected and a casehardened shell surrounds a still moist center, the head is likely to burst open, at times with a sharp report. This tendency is due to the release of internal stresses set up by improper seasoning, and results principally from drying bolts in a dryer in which the drying conditions can not be controlled, or by exposing them to the hot sun.

Dogwood bolts air-seasoned for mallet heads should be piled on sills off the ground so that air can circulate and in dry locations away from water or mud where weeds grow. They should also be protected by a roof from rain, snow, and sun.

TURNPINS

For shaping the ends of lead pipe, plumbers prefer dogwood turnpins (fig. 19) as they satisfactorily withstand battering and rough usage. The turnpins are made in various sizes on a lathe from round stock, and are sanded and coated with shellac before being sold.

MINE SPRAGS AND ROLLERS

A mine sprag (fig. 19) is a cylindrical piece of wood, generally with the bark on, pointed at both ends, about 21 inches long and from 2¼ to 3½ inches in diameter. It is used in coal-mining operations as a braking device on mine cars that are not provided with brakes. By jamming a sprag between the spokes of a rotating wheel the operator riding on the car locks the wheel and accordingly regulates the speed of the car.

Mine sprags must be made of hard, strong wood, for they are given rough usage. Dogwood is admirable for the purpose but is difficult to obtain. At present much larger quantities of oak, hickory, and hard maple are used, and there is a tendency to substitute iron pipe for wooden sprags. A few small mills scattered throughout Pennsylvania and West Virginia still cut mine sprags, however, and among the woods used dogwood is always desired.

Mine rollers are large cylinders placed under mine-car cables to keep the cables off the ground. A hard, dense wood is required and for this purpose dogwood is very satisfactory. However, at present the cores of black gum and other veneer logs are being used largely for mine rollers, and the practice is greatly to be preferred to using young dogwood trees.

QUILLS

A great many small dogwood squares are used in the manufacture of quills (fig. 20) for the silk industry. The term "quill" is

applied to the wooden fixture which fits over the hinged spindle in a shuttle. The silk threads are unwound from this fixture as the shuttle shoots across the loom to make the woof of the material.

Soft, breakable, rough-finishing woods will not fulfill the quill requirements of the silk industry, but dogwood and boxwood are very satisfactory.

The hole bored through the fine cylindrically shaped quill makes the quill virtually a shell, and a wood softer or weaker than dogwood or boxwood is likely to break in use. Some users prefer dogwood quills and some boxwood. The boxwood quill is smoother and cleaner looking, but, being more brittle, is more apt to chip when turned, bored, or dropped. Chipped surfaces are always apt to catch threads and cause loom interruptions.

FLYER BLOCKS

Thousands of flyer blocks (fig. 20) are made from a small proportion of the waste in the ultilization of dogwood for shuttle blocks.

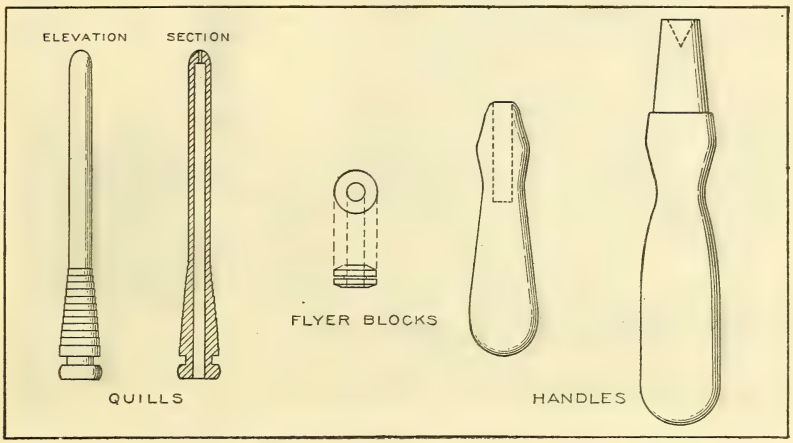


FIG. 20.—Products made from small dogwood dimension

Only a very few manufacturers make them, because they are troublesome to manufacture and must be exact as to size. As with other products for textile mills, the dogwood flyer block is superior to those of other woods.

GOLF-CLUB HEADS

Approximately 1,000 cords of persimmon, the equivalent of 500,000 board feet, log scale, is used annually for golf-club heads. Practically all golf-club heads at the present time are made from persimmon. There was a time when dogwood was largely used for this purpose, but the difficulty of obtaining dogwood in large enough sizes has practically eliminated it. A golf-club head, though a small article when completed, must be cut from a rather sizable piece of wood. Persimmon, although it is not quite so hard as dogwood, is well suited to the purpose.

In making golf-club heads the persimmon logs are cut into short bolts from 3 to 4 feet long (fig. 21). Two thick slabs are cut on opposite sides of each bolt, leaving in the middle a third piece of equal thickness containing the pith. The slabs and center pieces are then ripped to the approximate thickness of the block required, about 3 inches, and to a breadth of 3½ to 6 inches corresponding to the length of the head. The slabs and thick pieces, most of them still retaining a strip of bark, are seasoned in the open air for several months (fig. 22). They are then cut into smaller blocks approximating the rough shape of the head, which are spread on the floor in open sheds and covered with burlap sacks to season further. These blocks are turned over with shovels periodically so that the seasoning proceeds uniformly with the smallest amount of checking. Changes in weather often have a marked effect on the seasoning.

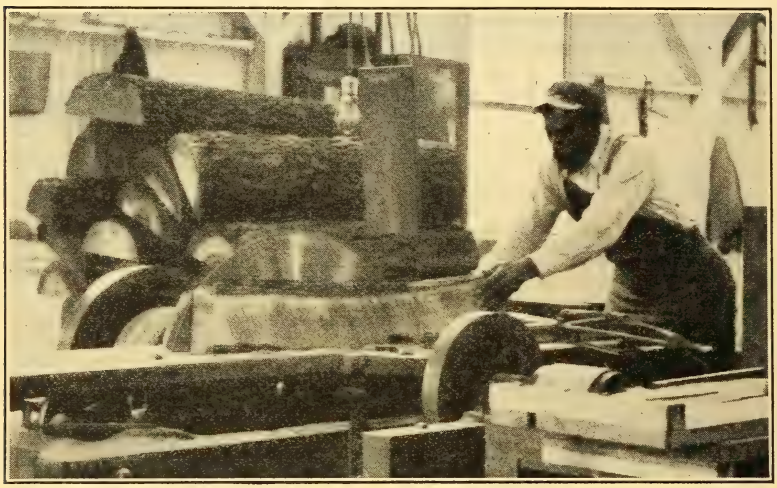


FIG. 21.—Sawing strips of persimmon for golf-club heads

The rough blocks, when thoroughly air seasoned, are placed in lathes and shaped into blanks according to metal patterns. A hole is bored for the shaft, and the blank is finally sanded and made ready for the sporting goods and athletic supply companies to complete the golf club.

Experiments have recently been made in kiln-drying persimmon blocks for golf-club heads at the Forest Products Laboratory. One of the blocks was completely covered with gloss oil and dried in a hot box at 160° F. without any humidity. Twenty-five days were required to dry from approximately 40 per cent moisture to 8 per cent without any checking. Some end checking developed in a kiln run which required only 18 days.

SHOE LASTS

Approximately 100,000 rough persimmon blocks, the equivalent of 150,000 feet board measure, log scale, are used for shoe lasts. This is a much smaller quantity than was at one time used, and is the re-

sult of the scarcity and consequent advanced price of persimmon blocks. These 100,000 blocks are made into lasts for children's shoes which are small and the design of which does not change frequently. Lasts for women's shoes change so frequently that the expense of discarding persimmon lasts would be too great.

For other lasts the industry has been forced to substitute maple, although persimmon is harder, withstands battering better, and is more wear resistant. This illustrates one of many substitutions in American industry of less satisfactory woods, because of depletion of our timber, and in this case timber with properties that give it highly specialized uses.

Persimmon dimension manufacturers sell both sawed and rough-turned blocks to last manufacturers. The lasts are turned to the

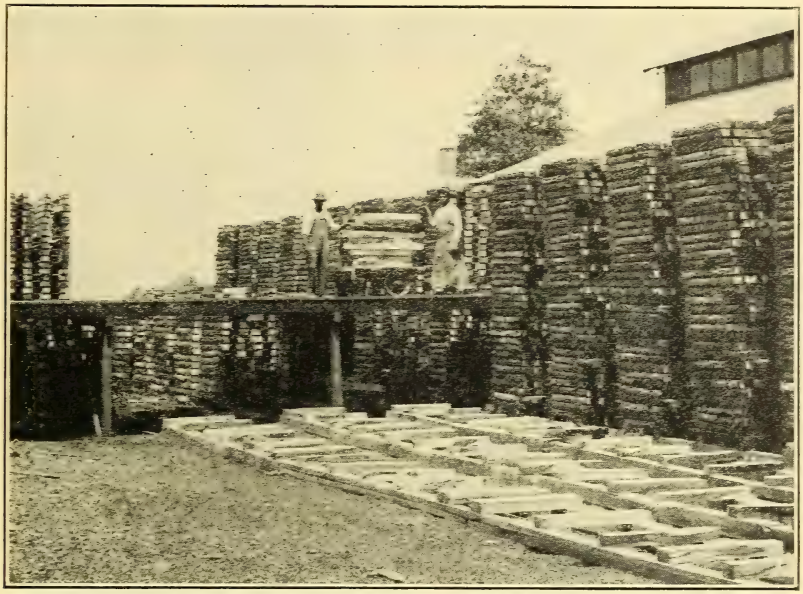


FIG. 22.—Sawed strips of persimmon for golf-club heads drying in the open

shape of a metal pattern, are sanded, polished, and given a coat of shellac in the process of manufacture. Some difficulty is experienced in maintaining the exact size of the lasts throughout the year. Like the shuttles, they absorb moisture in factories in the summer when the windows are open and swell accordingly; in winter, with artificial heat in the building and the windows closed, the lasts shrink. The shellac coating is not moisture proof. In the manufacture of shoes this change, no matter how slight, is exceedingly annoying. Persimmon, being more dense than maple, will swell and shrink somewhat more, and this fact constitutes the only objection to it for this use. Like the shuttle manufacturer, the shoe-last manufacturer would welcome an impregnating material which would be impervious to moisture and would hold constant the shape of the lasts.

MISCELLANEOUS USES

In the past, because of its properties, dogwood has been used for bearings for machinery, dowels, rake and harrow teeth, meat skewers, toothpicks, vine stakes, hubs of small wheels, barrel hoops, walking sticks, hay forks, hog yokes, distaffs for spinning, hames, jaws for small vises, engravers' blocks, and cabinet work, such as knobs and carved decorations on fronts of drawers. It has also been used for fuel (fig. 23), gunpowder charcoal, measuring rules, paper knives, and novelties. It is used locally at the present time for mauls, wedges and gluts, sled runners and similar products where hardness, toughness, and the characteristic of wearing smooth are essential.

Woodsmen, farmers, woodland owners, and settlers who have occasion to use sleds without metal runners find dogwood or persimmon runners excellent substitutes, especially sticks with a natural bend, like the turned end of the sled runner. The runners become extremely smooth from use.

Some dogwood is used in the manufacture of knitting needles, carpet needles, etc. Knitting needles being long and slender and requiring smooth-wearing qualities are very satisfactory when made from dogwood. The dogwood meat skewer has been replaced by the more plentiful beech and maple.

Jewelers prefer dogwood blocks for bench work, and dogwood sticks for cleaning deep-seated lenses, because the wood resists wear and at the same time does not scratch glass lenses or other delicate parts.

SUBSTITUTE WOODS

The increasing difficulty in obtaining good dogwood and persimmon brings attention to a number of woods with similar properties which may possibly make satisfactory substitutes for shuttle blocks. A number of such woods are discussed below, and in Table 4 their properties are compared. The values of the flowering dogwood, which has proved itself eminently suited for shuttles, are in most cases higher than the values of the other woods, as shown in the table, and may be used as a basis for comparison. It is impossible, however, from a mere comparison of the mechanical properties to tell whether or not a wood will make satisfactory shuttles. Only a thorough trial of shuttles made from the woods will prove the point.

Manufacturers interested can readily obtain sufficient bolts to make a number of shuttles of some of the woods mentioned. The shuttles should be given a thorough trial in looms of textile mills. Shuttles of persimmon and flowering dogwood tested under like conditions at the same time will afford a comparative check on the results. The experiment, if comprehensive enough, should prove the fitness or unfitness of the new woods for shuttles. It is quite possible that several will abrade as smoothly as dogwood or persimmon shuttles, and this is one of the chief considerations.

In 1910 some bolts of western woods were received and made into shuttles by a manufacturer, and the shuttles tried in looms. Unfortunately, the bolts were of very poor quality and the test of the shuttles was not sufficiently extensive. A number of shuttle-block

and shuttle manufacturers report that in years past they have tried one or two of the woods listed in the table, and that the results were not entirely satisfactory. In each instance, however, it seems that the fault was not so much in the properties of the wood as in the quality of the bolts submitted for trial.

Should any of the woods from the West prove otherwise satisfactory for shuttles the conditions of labor for cutting and marketing the trees would differ considerably from those in the East, where farmers, woodland owners, and merchants are more readily available for the job of supplying the demand for raw material.

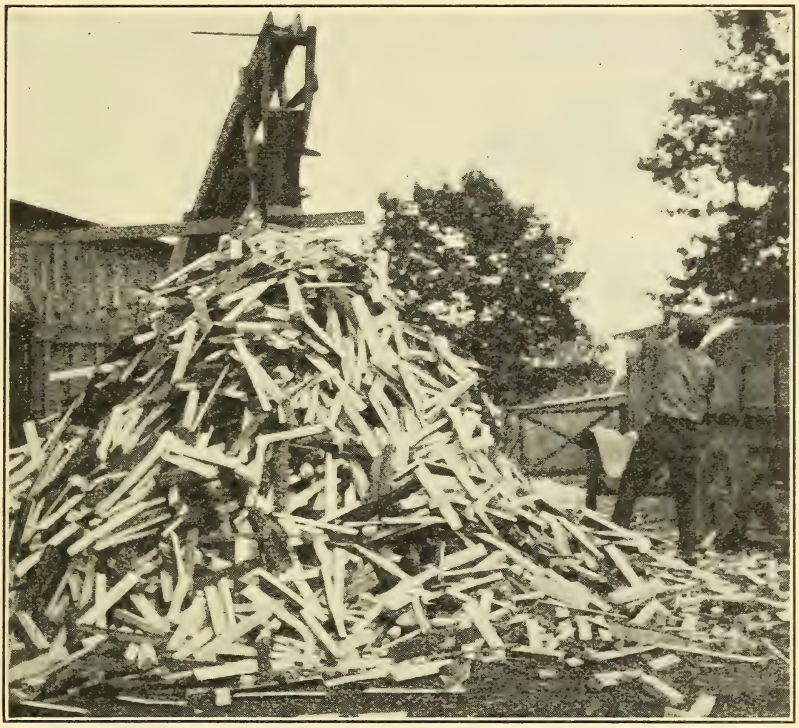


FIG. 23.—Waste edgings for use as fuel

More difficulty in obtaining adequate quantities of the rough bolts might therefore be experienced in the West.

BLUE BEECH

The blue beech (*Carpinus caroliniana*), which occurs most abundantly and in largest size on the western slopes of the southern Allegheny Mountains and eastern Texas, sometimes attains a diameter of 20 inches and a height of 30 or 40 feet. Because it grows among larger hardwoods, blue beech is almost entirely disregarded, except for the very finest trees, which are cut into stock for handles and vehicles. No thorough trial of blue beech for shuttles has ever been made. Its scattered occurrence presents very much the same problem in cutting and marketing as does dogwood.

TABLE 4.—*Strength and related properties of dogwood and persimmon compared with other woods suggested for trial as shuttle material*[1]

Common and botanical names and place of growth of material tested	Number of trees	Number of rings per inch	Specific gravity based on weight when oven dry and volume at 12 per cent moisture	Shrinkage from green to oven-dry condition (dimensions when green)			Static bending						Impact bending				Compression parallel to grain			Compression perpendicular to grain	Hardness			
				In volume	Radially	Tangentially	Fiber stress at elastic limit	Modulus of rupture	Modulus of elasticity	Work			Fiber stress at elastic limit	Modulus of elasticity	Work to elastic limit	Height of drop causing complete failure (50-pound hammer)	Fiber stress at elastic limit	Maximum crushing strength	Modulus of elasticity	Fiber stress at elastic limit	Load required to imbed a 0.444-inch ball to one-half its diameter			
										To elastic limit	To maximum load	Total									End	Radial	Tangential	Average radial and tangential
				P. ct.	*P. ct.*	*P. ct.*	*Lbs. per sq. in.*		*1,000 lbs. per sq. in.*	*In.-lbs. per cu. in.*			*Lbs. per sq. in.*	*1,000 lbs. per sq. in.*	*In.-lbs. per cu. in.*	*In.*	*Lbs. per sq. in.*		*1,000 lbs. per sq. in.*	*Lbs. per sq. in.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Beech, blue (*Carpinus caroliniana*), Massachusetts	12	15.2	0.694	19.1			3,800	12,000	1,070	0.77	36.2	76.0	10,300	1,420	4.3		3,090	5,580	1,130	1,930	1,590	1,750	1,760	1,750
Hornbeam (*Ostrya virginiana*), Wisconsin	5	28.8	.708	18.6	8.2	9.6	9,700	14,500	1,720	3.12	14.1	31.0	14,300	1,930	5.9	48	5,760	8,150	1,690	1,570	2,270	1,880	1,920	1,900
Madrona (*Arbutus menziesii*), Oregon and California	6	9.9	.553	17.4	5.4	11.9	7,500	10,700	1,260	2.53	4.6	11.6	10,400	1,500	4.4	22	4,220	7,170	1,470	1,680	1,950	1,520	1,480	1,500
Myrtle, oregon (*Umbellularia californica*), Oregon	5	5.5	.556	11.9	2.8	8.1	5,500	8,100	950	1.89	7.9	11.2	10,800	1,280	5.4	30	3,760	5,860	1,020	1,430	1,570	1,220	1,360	1,290
Oak, Canyon live (*Quercus chrysolepsis*), California	3	12.9	.778	16.2	8.0	14.3	9,500	13,100	1,620	3.28	9.6	18.8	13,300	1,730	5.6	36	6,420	9,450	2,030	2,300	2,580	2,490	2,430	2,460
Dogwood, flowering (*Cornus florida*), Tennessee	5	24.1	.735	19.9	7.1	11.3	9,400	15,300	1,550	3.26	19.4	39.0	15,100	1,650	7.8	44		7,980		1,970	2,470	2,200	2,180	2,190
Dogwood, Pacific (*Cornus nuttallii*), Oregon	5	21.4	.644	17.2	6.4	9.6	7,500	10,600	1,490	2.10	10.8	32.2	10,500	1,640	3.7	33	4,340	7,780	1,990	1,700	1,910	1,380	1,380	1,380
Persimmon (*Diospyros virginiana*), Missouri	5	13.8	.748	18.3	7.5	10.8	11,300	18,100	2,050	3.65	15.7	35.2	18,600	2,420	8.7	36	6,450	9,550	2,050	2,550	2,620	2,280	2,420	2,350
Yew, Pacific (*Taxus brevifolia*), Washington	5	26.8	.626	9.7	4.0	5.4	9,400	15,400	1,370	3.63	18.7	29.0	12,100	1,530	5.4	31	4,450	8,250	1,240	2,170	2,050	1,790	1,430	1,610

[1] Results of tests on specimens 2 by 2 inches in section. Bending specimens 30 inches long; others shorter, depending on kind of test. The values are for seasoned material adjusted to an average air-dry condition of 12 per cent moisture.

HORNBEAM

The hornbeam or ironwood (*Ostrya virginiana*) is most abundant and largest in southern Arkansas and eastern Texas. It is closely related to the blue beech but reaches a larger size, occasionally 24 inches in diameter and 60 feet high. It, too, associates with larger hardwoods and is not used to any great extent commercially. Cutting and marketing it would present a problem very similar to the cutting and marketing of blue beech and dogwood.

MADROÑA

Madroña (*Arbutus menziesii*) is common and of largest size in the redwood forests of northern California. The tree often grows from 60 to 80 feet high, with a straight, clean trunk 2 to 3 feet in diameter; but more frequently it is low and shrubby, or from 25 to 40 feet high with a crooked or leaning trunk 8 to 15 inches through.

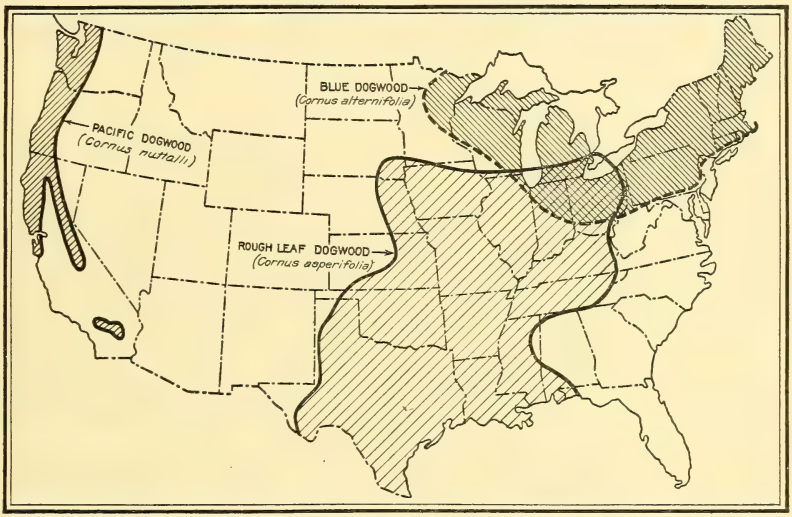


FIG. 24.—Natural range of three less important dogwoods

The wood is of fine texture and pale reddish brown in color, with a thin whitish sapwood. Small quantities of it are used for flooring for which it is very beautiful and serviceable.

OREGON MYRTLE

Oregon myrtle (*Umbellularia californica*), sometimes known as California laurel or pepperwood, is most abundant and largest in size in the rich valleys of southwestern Oregon, where it forms a considerable part of the forest growth. The tree is commonly 60 to 80 feet high and 2½ to 3 feet through. Occasionally in the dense forest it has a clean, straight trunk 30 to 40 feet long. The wood is yellowish brown and often mottled, and the sapwood is very thick.

It is used for turnery, furniture, musical instruments, and inside finish of boats, and has a beautiful figure when polished.

CANYON LIVE OAK

Canyon live oak (*Quercus chrysolepsis*) is an evergreen oak, with the soft, scaly trunk bark of a white oak. Its range is very wide, spreading from the southwestern corner of Oregon southward throughout the mountains of California, except the east side of the Sierras, to the mountains of central and southern Arizona. In the northern part of its range it occurs at elevations of 1,000 to 5,000 feet; in the southern part at 2,500 to 9,000 feet.

It varies in size from low, dense chaparral brush to a wide-spreading tree 30 or 40 feet high with huge horizontal limbs and a short, thick, clear trunk 30 to 60 or more inches in diameter, developed in the open. In sheltered canyon bottoms, in groups, canyon live oak develops 15 or 20 feet of clear, straight trunk with little taper.

The wood is light brown in color, variable in texture from fine to coarse, and is exceedingly tough and strong. Small quantities of it are used locally for wheel stock and farm implements.

PACIFIC DOGWOOD

The range of Pacific dogwood (*Cornus nuttallii*) extends from the southern coast of British Columbia through Washington, Oregon, and California (coast ranges to San Jacinto Mountains and western slopes of the Sierra Nevada Mountains). The average tree is larger than the flowering dogwood of the East. The largest trees are found in the heavy Douglas fir forests of the country around Puget Sound in western Washington. Pacific dogwood occurs singly or in small groups with Douglas fir, redwood, western hemlock, and sometimes with western yellow and sugar pine. The species with which it associates are of such importance that heretofore the dogwood has not been given commercial consideration. The mechanical properties of Pacific dogwood are listed in Table 4.

In structure and appearance the wood is very similar to the flowering species. The pores are minute and fairly evenly distributed, the rays are very similar, though slightly narrower, and the color and grain are very much alike. As in the flowering dogwood, the pores are not so large as the pores of persimmon, and they are more evenly distributed throughout each growth ring. From a visual examination it is difficult to distinguish Pacific from flowering dogwood.

PACIFIC YEW

Pacific yew (*Taxus brevifolia*) reaches its largest size in western Oregon, Washington, and British Columbia, where it occurs near margins of low mountain streams and on moist flats and benches. It is a small tree, usually 20 to 30 feet high and 6 to 12 inches in diameter. Occasionally it reaches 75 feet in height and 30 inches in diameter. It is very commonly used for bows in archery, a purpose for which it is highly desirable.

SUMMARY

All indications point to increased curtailment of the supply of dogwood and persimmon, if present cutting and manufacturing practices are continued. It is necessary, particularly with dogwood, that greater protection be given the trees when the larger and more common species with which they are associated are being cut. Because of the comparatively small size of dogwood, many operators not realizing its value have either not harvested it or have carelessly injured it in falling and removing the other timber.

The more progressive operator is finding it profitable to cut and remove the dogwood as a distinct operation before the regular logging operation begins. There is still, however, much avoidable injury done to the small unmerchantable trees which in a few years, as a result of freedom from crowding and shading by other trees, would reach merchantable size.

In handling dogwood bolts, persimmon logs, and shuttle blocks there is great loss through improper seasoning. Many do not appreciate the extent of the loss in checking, warping, and twisting; or if they appreciate it, do not understand the simple steps necessary to prevent it, at least in part. The loss is in many cases considered unavoidable and a necessary evil, which is not at all the case. Success or failure is often determined rather by the extent of the losses in raw material during the seasoning process than by methods of manufacture.

There will be opportunity also for economy of material in manufacturing shuttles, particularly when the textile manufacturers cease to demand shuttles absolutely free of defects. They have been so accustomed to obtaining without any difficulty shuttles made from perfect stock that they do not consider that shuttles with minor defects will operate quite as satisfactorily in the loom.

Although most manufacturers of both shuttle blocks and shuttles can readily dispose of their slabs, edgings, and rejects locally for fuel, there is an opportunity to sell this material at greater profit to manufacturers of handles for small products, such as knives and high-grade brushes. This is particularly true of the rejects of shuttle manufacturers. The conversion of slabs, edgings, and rejects into sizes suitable for smaller products is expensive, but dogwood and persimmon are so well suited for certain small articles that prices sufficient to cover this expense should be obtained. Many consumers are paying more for foreign woods which are less desirable for this purpose than dogwood or persimmon. Concerted efforts should be made by manufacturers to find the consumers who will take continuously definite quantities of the small dimension stock that can be cut.

Throughout the East and the West there are woods with properties similar to dogwood and persimmon which as yet have not been tried for shuttles. A thorough investigation sponsored by block and shuttle manufacturers and interested leaders in the textile industry, which could readily include certain foreign species, would in all probability reveal very interesting and valuable facts.

There is need for the development of an impregnating material to make dogwood and persimmon more resistant to moisture. At the same time investigations of this character might well include im-

pregnation of less valuable woods to develop in them a finish similar to that of dogwood and persimmon in their natural state.

Textile and shuttle manufacturers at present display undue confidence in the sufficiency of the supply of raw material for shuttles. Although it is true that curtailment may not be imminent, some organized action and research on the part of those especially interested will not only go far toward postponing future curtailment of the woods at present used, but may also make available certain native or foreign species not now used, and thus increase the supply of woods suitable for shuttles.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

September 3, 1926

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